

## **Pushing Buttons Report by Remin Reji Mathew and Yashna Shetty**

While playing Buttons, we began with puzzle one. This instantiated the rules of the game. When we pushed a button, the neighbouring buttons, either vertically or horizontally in line with the pushed button, would also activate, inverting their current status from either up or down, to either down or up, respectively. That is, from 0 to 1, or from 1 to 0, with 1 being down and 0 being up.

With this in mind we solved the puzzles proceeding. The following report will discuss the methodology employed to solve puzzles 8, 17, and 24.

### **Puzzle Eight**

Admittedly, by puzzle 8 we had yet to employ any particular strategy outside of trial and error. Given the small size of the puzzle, the minimal number of moves were easy to find. The minimal number of moves required to complete puzzle 8 were 3:

Move One: Red circle

Move Two: Red diamond

Move Three: Blue circle

Cleared.

### **Puzzle Seventeen**

By puzzle 17, the puzzles grew too large to employ trial and error. To gather a minimal solution, firstly, we work under the assumption that the puzzle is in fact solvable, and then attempted the “chasing the light” method that is often employed for similar button pushing puzzles. Essentially, this approach focuses on one row at a time. Starting at the top, we attempted to “chase” the button ups, mirroring our actions on the opposite side.

Through this method, we found that minimal number of actions in which we could complete the puzzle was 10:

Move One: Blue circle

Move Two: Yellow square

Move Three: Orange circle

Move Four: Purple square

Move Five: Orange diamond

Move Six: Red triangle

Move Seven: Purple star

Move Eight: Green star

Move Nine: Blue circle

Move Ten: Purple square

Cleared.

## **Puzzle Twenty-Four**

Once again, we employed the “chasing the light” method. At first, we attempted a top to bottom approach but quickly realized a minimal solution would not be achieved this way due to the asymmetry of the given puzzle.

Our solution to this was to work out the puzzle in a pattern that would reflect some form of symmetry; that is, from the bottom right and moving up and to the left. We also shifted the focus to clearing the columns instead of the rows until we reached the top row and “chased” the buttons back down to fix each row. The method produced the following minimal solution that consisted of 6 moves:

Move One: Blue cross

Move Two: Yellow star

Move Three: Purple diamond

Move Four: Yellow diamond

Move Five: Green diamond

Move Six: Yellow star

Cleared.

## **Conclusion**

To surmise, the common approach to all three was the “chasing the light” method and the view of symmetry. We attempted to move the on’s and off’s in manners that reflected its existence – for example with puzzle 24 we worked with the entire puzzle at a 45 degree angle so both sides of the puzzle had the same number of buttons. For this reason, the “chasing the light” method seemed the most appropriate to find the minimal solution.

To make sure the solution we found was in fact minimal, we brute-forced the puzzles multiple times. We also made alternative proceeding moves for each move in our minimal solution to see if this would change our solution at all. Each instance for seeking a further minimal solution resulted in a solution consisting of more moves than we had originally found. Once we confirmed that a more optimal solution could not be found, we concluded that we had found the best solution.