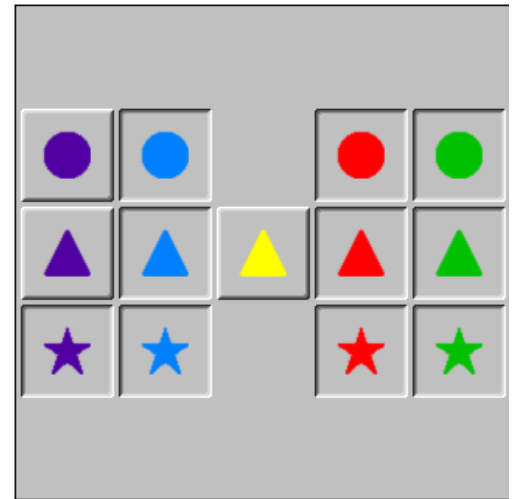
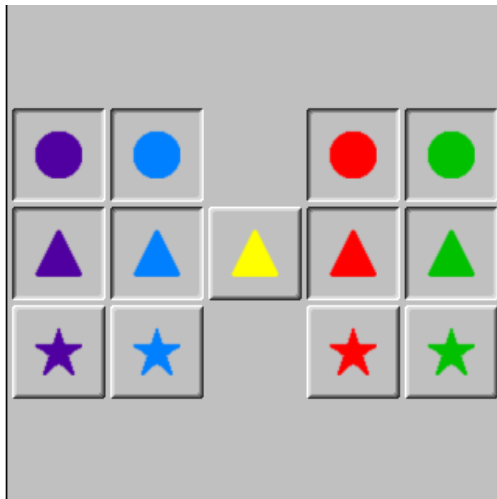


Etude 10 - Pushing Buttons
Katherine Butt - 4347525
Ava Reese - 2678742

Process Used to Find the Solutions:

We began by trying to solve the simple puzzles. During this process we worked out that certain buttons influence the nature of others. Once we noticed this we started to make note of what each button changed if it was the first to be pressed. This is when it became apparent that each button would affect all the buttons in the same row and column as itself.



The image on the left shows puzzle 15 before any buttons are pressed.

The image on the right shows puzzle 15 after the purple star is pressed.

This shows that when the purple star is pressed all of the buttons along the bottom row are influenced in this case pressed and all of the buttons in the same column are also influenced in this case the buttons are released.

From here we began to solve the required puzzles starting with puzzle 8.

We used a process of elimination to solve the puzzles. This meant trying different combinations of buttons and slowly eliminating the incorrect order of buttons. Each time we completed the puzzle successfully we took note of the number of button presses it required to be completed. To begin with these numbers were rather high and we were always aiming to better this number. Once we reached a number of button presses we felt was reasonable for the puzzle we stopped the iterative process.

NOTE: Each step indicates what button we pressed to reach our solution and max number of moves.

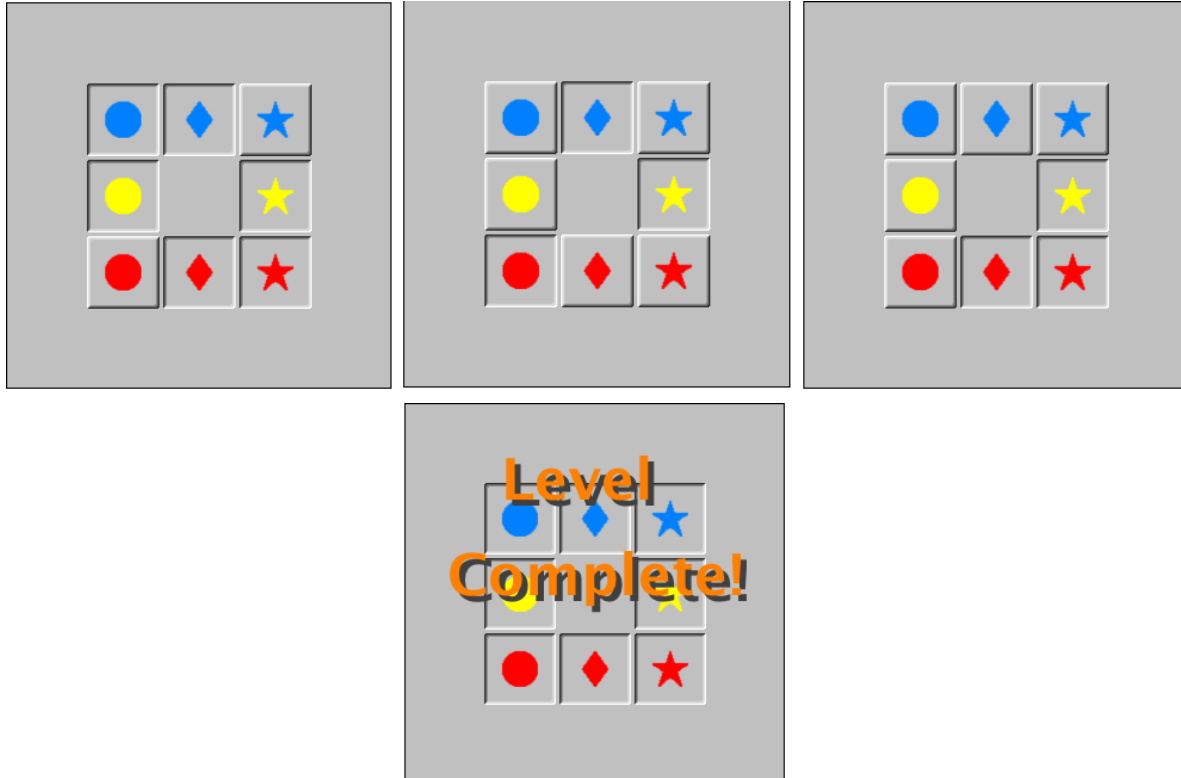
Level 8

Max Number of Moves Needed = 3

Step 1: Red Circle

Step 2: Red Diamond

Step 3: Blue Circle



By pressing either the blue star or red circle to start with it releases all of the buttons above and to the side of the button chosen. Then by pressing any of the buttons beside the original button pressed, therefore either a blue diamond, or yellow star if blue star is pressed and red diamond, or yellow circle if the red circle is pressed it will cause all the buttons along two connected sides to be released. The puzzle can then be solved by pressing the only available button in the corner. As only 3 steps are needed it indicates that puzzle 8 is a relatively easy puzzle to solve.

Level 17:

Max Number of Moves Needed = 10

Step 1: Blue Circle

Step 2: Orange Circle

Step 3: Orange Diamond

Step 4: Yellow Box

Step 5: Purple Box

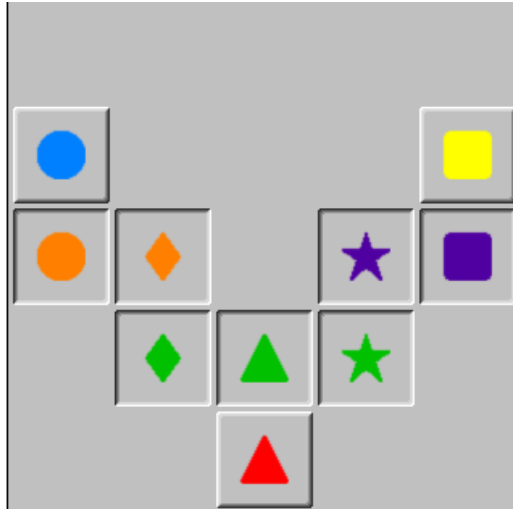
Step 6: Purple Star

Step 7: Green Star

Step 8: Purple Box

Step 9: Blue Circle

Step 10: Red Triangle



We found puzzle 17 to be the hardest puzzle to solve due to the layout of the buttons. For this puzzle we found that it was best to try and eliminate buttons from the top down. This meant that we first got the blue circle and yellow box pressed then worked down and inwards. Our solution required for this puzzle requires some buttons to be pressed more than once. We found this to be the case because so many of the buttons are pressed to begin with yet the bottom middle button needed to be pressed. Due to some of the buttons being pressed more than once the lowest number of steps we managed to generate was 10.

Level 24:

Max Number of Moves Needed = 6

Step 1: Blue Cross

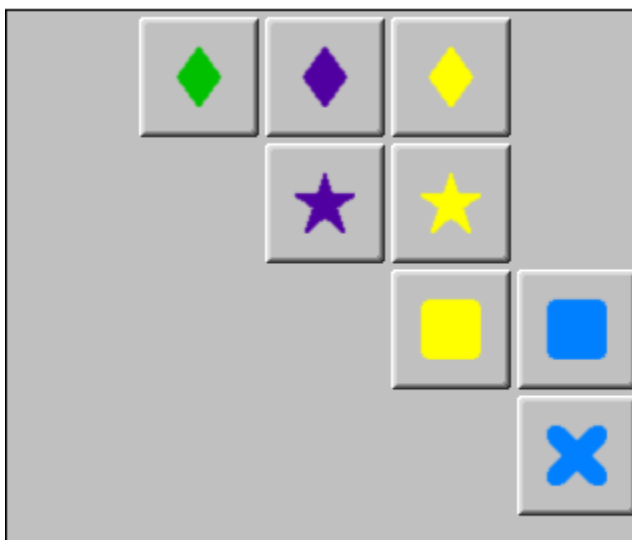
Step 2: Green Diamond

Step 3: Yellow Star

Step 4: Yellow Diamond

Step 5: Purple Diamond

Step 6: Yellow Star



From our first attempt to solve puzzle 24 we noticed that the blue cross only impacts the blue square therefore these are two buttons that are easy to eliminate. This however would only remain true if we didn't press the yellow box. This therefore meant we solved the puzzle for three buttons pretty much instantly. This just left the top 5 buttons to solve. Because so many of the buttons in this puzzle influence each other particularly with the top 5 buttons we realised it was very important to press the buttons in the correct order to ensure that work was not undone and the smaller number of steps used. For us we worked this out using a process of elimination. While working through the options we managed to get it done in 6 steps but as we hadn't taken note of what order we pressed the buttons we then had to work towards the number of steps again. However because we had a number of steps we were targeting we kept note of what buttons we pressed and when we pressed them.

In summary, we found that once we understood that the algorithm being used to control the buttons was that for any given button, once it was pressed any other buttons in the same row or column would be affected. This meant we could work out what each button would do when we pressed it before we pressed it therefore allow for a process of elimination to find the solution.

Developing an algorithm to apply to all the puzzles:

Two key rules are required for this generic algorithm that can be used to solve these puzzles.

- Rule 1: Find the button with the most prominent colour
- Rule 2: Find the button with the shape that occurs most often

For this algorithm these rules are applied together meaning that everytime a button is pressed it will be the button with the shape and colour which is occurring most often for the current puzzle shape.

A simple pseudo-code algorithm is:

Use a separate variable to store how many times each shape is occurring

Circlecount = 0

Diamondcount = 0

Starcount = 0

Trianglecount = 0

Boxcount = 0

Use a separate variable to store how many buttons are of each colour

Blue = 0

Green = 0

Red = 0

Yellow = 0

Use a for loop to iterate over each of the buttons in the puzzle

```
for(button in row){  
    Increase the count by 1 for the corresponding shape  
    Increase the count by 1 for the corresponding colour  
}
```

Check for which shape and colour has the highest count

```
maxShape = shape1  
while(hasNextShape){  
    if(shape2 > shape1){  
        maxShape = shape2  
        Shape1 = shape2  
        Shape2 = shape3  
    }  
}
```

```
maxColour = colour1  
while(hasNextColour){  
    if(colour2 > colour1){  
        maxColour = colour2  
        Colour1 = colour2  
        Colour2 = colour3  
    }  
}
```

buttontoPress = maxShape + maxColour

Press the button stored in buttontoPress

END//

Brief Description to Solve the Problems in General:

Due to the optimum button press always being the button which combines both the most common shape and colour this algorithm will allow any of the puzzles to be solved. Furthermore because this algorithm can have a pre-created algorithm for every possible colour and shape it can work for any possible buttons furthermore if a particular colour or shape doesn't occur their respective count's will remain at zero. This means they will never become the buttontoPress. This algorithm will be repeated until the puzzle is solved. Therefore it can be applied as a recursive algorithm continuously calling itself every time the puzzle isn't solved when the button

is pressed. In conclusion this generic pseudo algorithm can be used to solve any of the puzzles in general.