Rendering

- In order to keep a faster and easier interface for drawing pixels, I used a bitmap, represented by a matrix of unsigned char for keeping track the colors of the pixels on the screen. At every display rendering callback, I only render the buffer, instead of each shape.
- In order to draw a pixel, you can set the color of the corresponding element in the bitmap.

Color Filling Algorithms

Flood Filling

- The problem with flood filling is that its recursive nature is prone to stack overflow error. In order to solve this problem, I simulate the algorithm's DFS strategy with a stack:

```
static void floodFillColoring(int x, int y)
    {
        RGBColor borderColor(0, 0, 0);
        stack<pair<int, int>> S;
        S.push({x, y});


        // while stack is not empty
        while (!S.empty()) {

            // pop from the top
            pair<int, int> top = S.top();
            S.pop();
            x = top.first, y = top.second;

            if (bitMap[x][y] == fillingColor || bitMap[x][y] == borderColor) {
                continue;
            }

            bitMap[x][y] = fillingColor;

            int dx[] = {1, 0, -1, 0};
            int dy[] = {0, 1, 0, -1};

            // Starts filling adjacent pixels
            for (int i = 0; i < 4; ++i) {
                int newX = x + dx[i],
                    newY = y + dy[i];
                if (1 <= newX && newX <= WIDTH && 1 <= newY && newY <=
                HEIGHT && bitMap[newX][newY] != fillingColor && bitMap[newX][newY] != borderColor) {
                    S.push({newX, newY});
                }
            }
        }
    }
```

Scan Line Filling

Scan Line is highly dependent on the properties of the shape, so each shape gets its own implementation

Circle + Ellipse

Iterate a point (x, y) along the circumference from 0 to 180 degree. At each step, draw a line from the (xt - x, yt - y) to (xt + x, xt + y) with xt, yt being the coordinates of the center.

Rectangle

Iterate a point (x, y) along the left side of the rectangle. At each step draw a line from the (x, y) to (x2, y), with x2 being the maximum x coordinate of the rectangle.

Polygon