



- 195 Removals + 108 Additions

```

1  /**
2  Name: Phoenix Bishea
3  Eid: pnb338
4
5  Q1: Why are the arrays passed to both print life functions c
   onst?
6
7      The arrays passed to print life are not being directly m
   odified.
8
9      Since the value never changes it can be declared const.
10
11 Q2: Why are the arrays passed to both play life functions no
   t const?
12
13     The arrays passed to play life are not const because the
   y are modified.
14
15     Play life changes the cells in the array every iteration
   depending
16
17     on the rules of the game of life.
18
19 Q3: If we did change the arrays passed to play life function
   s to make them const,
20
21     what else would have to happen to make play life work?
22
23     Under these circumstances an additional array would have
   to be created and returned
24
25     from play life to main to make play life work. The array
   passed to play life could not
26
27     be modified.
28 */
29
30 #include <iostream>
31
32 using namespace std;
33
34 /// global constant for fixed rows and cols of the 2D array
35 const int NUM_ROWS = 10;
36 const int NUM_COLS = 10;
37 const int MIN = 0;
38 const int MAX = 9;
39
40 /** function declarations
41     you will need to write the definitions of these function
42     s below.
43     DO NOT MODIFY the declarations.
44     You may create your own functions, but you must use thes
45     e.
46 */
47
48 /** 2d array functions, notice that for 2d arrays the second
49 size
50
51     needs to be fixed, or more precisely it needs to be a co
52 nst.
53
54     if you typed a literal, like 5, it would be a literal co
55 nstant,
56
57     which also works.

```

```

1  /**
2  Name: Phoenix Bishea
3  Eid: pnb338
4
5  */
6
7  #include <iostream>
8
9  using namespace std;
10
11 const int numRows = 10;
12 const int numCol = 10;
13
14 //initialize arrays
15
16 void initializeArray(bool[][10]);
17 void printArray(const bool[][10]);
18
19 void playGameOfLife(bool[][10]);
20
21 int numNeighbors(const bool[][10], int row, int col);

```

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44 */
45 void printLife2DArray(const bool[][NUM_COLS]);
46 void playLife2DArray(bool[][NUM_COLS]);
47
48 /** Initializes the bool array created in main to the input
49 array.
50 Note: '*' is true and '.' is false.
51 */
52 void initializeLife2DArray(bool[][NUM_COLS]);
53 int getNeighbors(const bool[][NUM_COLS], int row, int col);
54
55 int main() {
56
57     /// read in the number of iterations to run
58
59     /** make a 2d bool array with the number of rows and col
60 s
61     Some input examples and explanation of game of life
62     Look at http://en.wikipedia.org/wiki/Conway%27s\_Game\_of\_
63 Life#Examples_of_patterns
64 */
65
66 /** print out what game we are playing */
67 // cout << "Game Of Life rows=" << /* n rows */ << " cols
68 =" << ncols <<
69 //      " iterations=" << /* number of iterations */ <<
70 endl;
71
72 /**
73 start your code
74 */
75
76 // reads in the number of iterations to run
77 int iterations;
78 cin >> iterations;
79 cin.ignore(); // consumes the newline character at the e
80 nd of the first line
81
82 // initializes a 2d bool array with the number of rows a
83 nd cols
84 bool arr[NUM_ROWS][NUM_COLS];
85 initializeLife2DArray(arr);
86
87 // prints the game we are playing
88 cout << "Game Of Life rows=" << NUM_ROWS << " cols="
89 << NUM_COLS <<
90 " iterations=" << iterations << endl;
91
92 // prints the initial board
93 printLife2DArray(arr);
94
95 // completes x iterations
96 for (int i = 0; i < iterations; i++) {
97     cout << endl;
98     playLife2DArray(arr);
99     printLife2DArray(arr);
100 }
101
102 return 0; /// return a ok

```

```

19
20 int main() {
21     int iters;
22     int nothing;
23     cin >> iters;
24
25     cin.ignore();
26     bool arr[numRow][numCol];
27     initializeArray(arr);
28
29
30
31
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33
34
35     // prints the game we are playing
36     cout << "Rows =" << numRow << " Columns =" << numCol
37 << " Number of iters =" << iters << endl;
38     printArray(arr);
39     for (int i = 0; i < iters; i++) {
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97 }
98
99 void initializeLife2DArray(bool arr[][NUM_COLS]) {
100
101     char line[NUM_COLS + 1]; // line to take in row input
102
103     // gets the first line
104     cin.getline(line, NUM_COLS + 1);
105
106     // sets values to true and false in the bool array
107     // '*' is true and '.' is false
108     for (size_t i = 0; i < NUM_ROWS; i++) {
109         for (size_t j = 0; j < NUM_COLS; j++) {
110             if (line[j] == '*') {
111                 arr[i][j] = 1;
112             } else {
113                 arr[i][j] = 0;
114             }
115         }
116         cin.getline(line, NUM_COLS + 1);
117     }
118 }
119
120 void printLife2DArray(const bool arr[][NUM_COLS]) {
121
122     // converts the bool array into the board of life
123     // '*' is true and '.' is false
124     for (size_t i = 0; i < NUM_ROWS; i++) {
125         for (size_t j = 0; j < NUM_COLS; j++) {
126             if (arr[i][j]) {
127                 cout << '*';
128             } else {
129                 cout << '.';
130             }
131         }
132         cout << endl;
133     }
134 }
135
136 void playLife2DArray(bool board[][NUM_COLS]) {
137
138     // creates a temporary board and sets it equal to the ga
139     me board
140     bool tempBoard[NUM_ROWS][NUM_COLS];
141     for (size_t i = 0; i < NUM_ROWS; i++) {
142         for (size_t j = 0; j < NUM_COLS; j++) {
143             tempBoard[i][j] = board[i][j];
144         }
145     }
146
147     // updates cells using the game of life rules
148     for (size_t i = 0; i < NUM_ROWS; i++) {
149         for (size_t j = 0; j < NUM_COLS; j++) {
150
151             // gets a cell's neighbors and status
152             int neighbors = getNeighbors(tempBoard, i, j);
153             bool alive = tempBoard[i][j];
154
155             // changes the cell's condition depending on its
156             neighbors

```

```

36 }
37
38 void initializeArray(bool arr[][numCol]) {
39     char letter[numCol + 1]; //take in row input
40     cin.getline(letter, numCol + 1); //return first letter
41     // '<' is true and '>' is false
42     for (size_t i = 0; i < numRows; i++) {
43         for (size_t j = 0; j < numCol; j++) {
44             if (letter[j] == '>') {
45
46                 arr[i][j] = 1;
47             } else {
48                 arr[i][j] = 0;
49             }
50         }
51         cin.getline(letter, numCol + 1);
52     }
53
54 void printArray(const bool arr[][numCol]) {
55     for (size_t i = 0; i < numRows; i++) {
56         for (size_t j = 0; j < numCol; j++) {
57             if (arr[i][j] && j < numCol) {
58                 cout << '>';
59             } else {
60                 cout << '<';
61             }
62         }
63         cout << endl;
64     }
65 }
66
67 int numNeighbors(const bool board[][numCol], int row, int co
68 l) {
69     int numNeighbors = 0; // initializes starting numNeighbo
70     rs
71
72     int sizeMin = 0;
73     int sizeMax = 9;

```

```

155         if (alive && (neighbors < 2 || neighbors > 3)) {
156             board[i][j] = 0;
157         } else if (!alive && (neighbors == 3)) {
158             board[i][j] = 1;
159         }
160     }
161 }
162 }
163
164 int getNeighbors(const bool board[][NUM_COLS], int row, int
165 col) {
166     int neighbors = 0; // initializes starting neighbors
167
168     // sets up the boundaries
169     bool colLessMax = (col + 1) <= MAX;
170     bool rowLessMax = (row + 1) <= MAX;
171     bool colGreaterMin = (col - 1) >= MIN;
172     bool rowGreaterMin = (row - 1) >= MIN;
173
174     // if the operation is within bounds, complete it and ta
175     // living
176     neighbors
177     if (colLessMax
178         && board[row][col + 1]) neighbors++;
179     // increment if a living neighbor is found
180
181     if (colGreaterMin
182         && board[row][col - 1]) neighbors++;
183
184     if (rowLessMax
185         && board[row + 1][col]) neighbors++;
186
187     if (rowGreaterMin
188         && board[row - 1][col]) neighbors++;
189
190     if (rowLessMax && colLessMax
191         && board[row + 1][col + 1]) neighbors++;
192
193     if (rowGreaterMin && colLessMax
194         && board[row - 1][col + 1]) neighbors++;
195
196     if (rowLessMax && colGreaterMin
197         && board[row + 1][col - 1]) neighbors++;
198
199     if (rowGreaterMin && colGreaterMin
200         && board[row - 1][col - 1]) neighbors++;
201
202     return neighbors;

```

```

71     // sets up the boundaries
72     bool ifminCol = (col + 1) <= sizeMax;
73     bool ifminRow = (row + 1) <= sizeMax;
74     bool ifmaxCol = (col - 1) >= sizeMin;
75     bool ifmaxRow = (row - 1) >= sizeMin;
76     // if the operation is within bounds, complete it and ta
77     // living
78     numNeighbors
79     if (ifminCol && board[row][col + 1]) numNeighbors++;
80     // increment if a living neighbor is found
81     if (ifmaxCol
82         && board[row][col - 1]) numNeighbors++;
83
84     if (rowLessMax
85         && board[row + 1][col]) numNeighbors++;
86
87     if (rowGreaterMin
88         && board[row - 1][col]) numNeighbors++;
89
90     if (rowLessMax && ifminCol
91         && board[row + 1][col + 1]) numNeighbors++;
92
93     if (rowGreaterMin && ifminCol
94         && board[row - 1][col + 1]) numNeighbors++;
95
96     if (rowLessMax && ifmaxCol
97         && board[row + 1][col - 1]) numNeighbors++;
98
99     if (rowGreaterMin && ifmaxCol
100         && board[row - 1][col - 1]) numNeighbors++;
101
102     return numNeighbors;
103 }
104
105 void playGameOfLife(bool board[][numCol]) {
106     //makes a temp board
107     bool temp[numRow][numCol];
108     for (size_t i = 0; i < numRow; i++) {
109         for (size_t j = 0; j < numCol; j++) {
110             temp[i][j] = board[i][j];
111         }
112     }
113     // updates each cell in the array

```

```
200 }
```

```
    for (size_t i = 0; i < numRows; i++) {  
112         for (size_t j = 0; j < numCol; j++) {  
113             int numNeighbors = numNeighbors(temp, i, j);  
114             bool isAlive = temp[i][j];  
             if (isAlive && (numNeighbors < 2 || numNeighbors  
115 > 3)) {  
116                 board[i][j] = 0;  
117             } else if (!isAlive && (numNeighbors == 3)) {  
118                 board[i][j] = 1;  
119             }  
120         }  
121     }  
122 }
```