Feedback from Quiz 4
• Array of classes vs. class holding arrays
• when is the keyword new used?
• Array index vs. array value: a[i] = v;
• How do we visit or revisit each element of an array?
• Functions: arguments, return values

Review
• Recursion
• Call Stack

Coding Examples
• recursive findMax

Two-dimensional Arrays
• Visualized as a grid
  • int[][] grays = {{0, 20, 40},
    • {60, 80, 100},
    • {120, 140, 160},
    • {180, 200, 220}};
  • int[][] grays = new int[4][3];

Indexing 2D Arrays
• Need two indices, one for the rows and one for the columns.
  • grays[2][1] = 255;
  • grays[2][3] = 0;

Lengths of 2D Arrays
• int[][] grays = new int[80][100];
• println(grays.length);
• println(grays[0].length);
Exercise

Add the necessary lines of code within `setup()` to fill the `vals` array with random numbers of your choosing. Your implementation must use for loops.

```java
float[][] vals;
void setup() {
    vals = new float[20][300];
    // Add your code here
}
```

Examples

- `graySquares`

Cellular Automata

A regular grid of Cells

Two States

1. On
2. Off

Neighborhood

Cell states evolve over time according to a predefined set of rules.

Sample Set of Rules – Conway's Game of Life

1. Any live cell with fewer than two live neighbors dies, as if caused by under-population.
2. Any live cell with two or three live neighbors lives on to the next generation.
3. Any live cell with more than three live neighbors dies, as if by overcrowding.
4. Any dead cell with exactly three live neighbors becomes a live cell, as if by reproduction.

An example of "Emergence"

Interesting Patterns – Conway's Game of Life

2D Array of Booleans

```java
int N = 5;
boolean[][] cell = new boolean[N][N];
```
int N = 5;
boolean[][] cell = new boolean[N][N];

cell[1][2] = true;

// 3-Dimensional Array
int N = 50;
boolean[][][] cell = new boolean[N][N][2];
cell[1][2][0] = true;

What are we printing?

float[][] vals;
void setup() {
    vals = new float[20][300];
    for (int i=0; i<20; i++) {
        println(vals[i].length);
    }
}