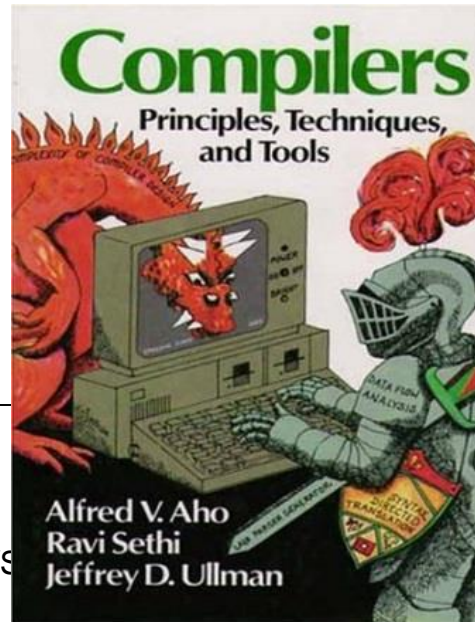


Topic 26

Two Dimensional Arrays

"Computer Science is a science of abstraction
-creating the right model for a problem and
devising the appropriate mechanizable
techniques to solve it."

-Alfred Aho and Jeffery Ullman



2D Arrays in Java

- ▶ Arrays with multiple dimensions may be declared and used

```
int[][] mat = new int[3][4];
```

- ▶ the number of pairs of square brackets indicates the dimension of the array.
- ▶ by convention, in a 2D array the first number indicates the row and the second the column

Two Dimensional Arrays

	0	1	2	3	column
0	0	0	0	0	
1	0	0	0	0	
2	0	0	0	0	

row

This is our abstract picture of the 2D array and treating it this way is acceptable.

(actual implementation is different)

```
mat[2][1] = 12;
```

What is What?

```
int[][] mat = new int[10][12];  
  
// mat is a reference to the whole 2d array  
  
// mat[0] or mat[r] are references to a single row  
  
// mat[0][1] or mat[r][c] are references to  
// single elements  
  
// no way to refer to a single column  
  
// mat.length is the number of rows  
// mat[0].length is the number of columns  
//     in row 0.
```

2D Array Problems

- ▶ Write a method to find the max value in a 2d array of ints
- ▶ Write a method that finds the sum of values in each column of a 2d array of doubles
- ▶ Write a method to print out the elements of a 2d array of ints in row order.
 - row 0, then row 1, then row 2 ...
- ▶ Write a method to print out the elements of a 2d array of ints in column order
 - column 0, then column 1, then column 2 ...

Clicker 1

▶ What is output by the following code?

```
String[][] strTable = new String[5][8];  
System.out.print(strTable.length + " ");  
System.out.print(strTable[0].length + " ");  
System.out.print(strTable[2][3].length());
```

A. 40 0 0

B. 8 5 0

C. 5 8 0

D. 5 8 then a runtime error occurs

E. No output due to a syntax error.

Use of Two Dimensional Arrays

- ▶ 2D arrays are often used when I need a table of data or want to represent things that have 2 dimensions.
- ▶ For instance an area of a simulation

Example of using a 2D array

- ▶ Conway's Game of Life
 - a cellular automaton designed by John Conway, a mathematician
 - not really a game
 - a simulation
 - takes place on a 2d grid
 - each element of the grid is occupied or empty

Simulation

- ▶ <http://www.cuug.ab.ca/dewara/life/life.html>
- ▶ Select pattern from menu
- ▶ Select region in large area with mouse by pressing the control key and left click at the same time
- ▶ Select the paste button

Generation 0

	0	1	2	3	4	5
0	.	*	.	*	.	*
1	*	.	*	*	*	*
2	.	.	*	*	.	*
3	.	*	*	*	.	*

* indicates occupied, . indicates empty

Or

	0	1	2	3	4	5
0		■		■		■
1	■		■	■	■	■
2			■	■		■
3		■	■	■		■

Generation 1

	0	1	2	3	4	5
0	.	*	.	*	.	*
1	*
2	*
3	.	*	.	*	.	.

* indicates occupied, . indicates empty

Or , Generation 1

	0	1	2	3	4	5
0		■		■		■
1						■
2						■
3		■		■		

Rules of the Game

- ▶ If a cell is occupied in this generation.
 - it survives if it has 2 or 3 neighbors in this generation
 - it dies if it has 0 or 1 neighbors in this generation
 - it dies if it has 4 or more neighbors in this generation
- ▶ If a cell is unoccupied in this generation.
 - there is a birth if it has exactly 3 neighboring cells that are occupied in this generation
- ▶ Neighboring cells are up, down, left, right, and diagonal. In general a cell has 8 neighboring cells

Clicker 2

- ▶ Implement a program to run the simulation
- ▶ What data type do you want to use for the elements of the 2d array?
 - A. String
 - B. char
 - C. int
 - D. boolean
 - E. double

Clicker 3

▶ Do you want to use a buffer zone on the edges?

A.No

B.Yes