2 Dimensional Arrays

- A 2D array is really just a 1 dimensional array of arrays

- int matrix[][];

  Here is what gets created in memory
  matrix: [null] // ref var allocated with a null in it

  The reference variable indicates it's a ref var for a 2D array by having a double set of brackets [][] in its declaration.
  Note that the above declaration of a ref var does not create any array yet.

- matrix = new int[5][3];

  Now we have created a 5 row by 3 col array of int.
  The address of where that array lives gets assigned into the reference variable named matrix.

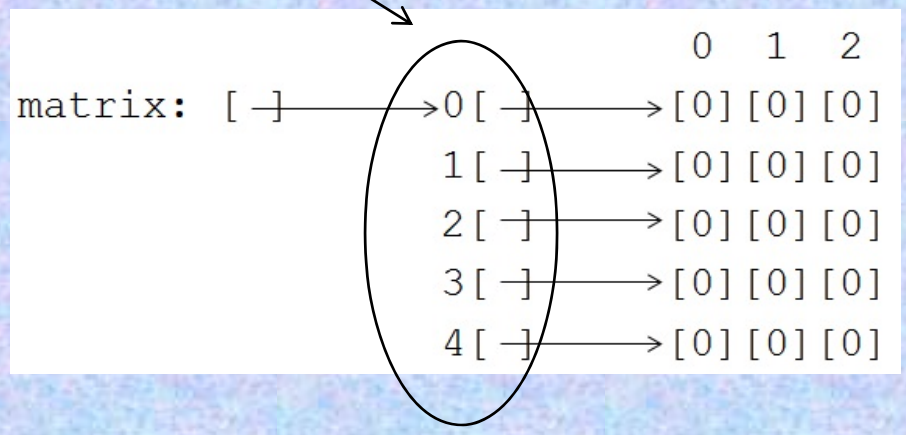
- Here is what memory looks like now:

```
                                0  1  2
matrix: [ ]──────────→0[ ]──────────→[0][0][0]
                      1[ ]──────────→[0][0][0]
                      2[ ]──────────→[0][0][0]
                      3[ ]──────────→[0][0][0]
                      4[ ]──────────→[0][0][0]
```

We usually visualize the array as just the grid part but in fact a 2D array is an array of arrays. Each row of the array is itself a 1D array. You could also say a 2D array is an array of references to 1D arrays

2D Arrays

- **The expression matrix refers to this part of memory**



2D Arrays

- matrix.length is 5
- matrix[0] is the ref to the first array.
- matrix[0].length is 3
- To find out how many rows in the entire matrix use matrix.length
- To find the length of a specific row use matrix[row].length

- To access individual elements of the matrix use this syntax:

```
matrix[3][2] = 7;
                0:  [0][0][0]
                1:  [0][0][0]
  puts a 7      2:  [0][0][0]
                3:  [0][0][7]
                4:  [0][0][0]
```

2D Arrays

- Rather than plinking individual values into a matrix with hardcoded indices in solitary assignment statements, arrays and matrices are generally initialized using loops.

- Use matrix.length to produce the number of rows. Use matrix[row].length to produce the number of columns in that row.

2D Arrays

```
int[][] matrix = new int[5][3];

for (int row=0 ; row < matrix.length ; row++ )
       for (int col = 0 ; col < matrix[row].length ; col++)
              matrix[row][col] = row+col;
```

```
matrix [] ──────────────→ [ ]→ [0][1][2]
                          [ ]→ [1][2][3]
                          [ ]→ [2][3][4]
                          [ ]→ [3][4][5]
                          [ ]→ [4][5][6]
```

The individual rows are not stored contiguously/consecutively in memory

Replacing entire rows with new rows

- If we start with:

```
matrix [-]-> [0]-> [0][1][2]
             [1]-> [1][2][3]
             [2]-> [2][3][4]
             [3]-> [3][4][5]
             [4]-> [4][5][6]
```

and do: matrix[2] = new int[7]; We get:

```
matrix [-]-> [0]-> [0][1][2]
             [1]-> [1][2][3]
             [2]-> [0][0][0][0][0][0][0]
             [3]-> [3][4][5]
             [4]-> [4][5][6]
```

A new row is created and its values set to 0s. The reference to the new array overwrites the old reference in slot [2]. All the old values in row [2] are lost unless we saved that reference value into a variable somewhere.