CSC 142

Multidimensional Arrays
[Reading: chapter 12]

2D arrays

- How to represent a table of data?
  - e.g. the daily rainfall over a period of 4 weeks

week \ day	Mo	Tu	We	Th	Fr	Sa	Su
1	2.3	2.0	0.9	0.1	1.2	2.1	0.0
2	1.3	0.0	2.9	1.1	0.2	0.1	0.0
3	0.3	0.0	0.8	1.1	2.2	2.5	2.0
4	1.2	0.7	0.3	0.0	1.4	2.6	1.3

- Need a 2 dimensional array: 4 rows times 7 columns

```
double[][] rainfall = new double[4][7];
rainfall[1][2]=2.9; //index starts at 0
```


Understanding 2D arrays

- rainfall is a 2D array made of 4 rows and 7 columns
- A 2D array is a 1D array whose elements are 1D arrays
  - rainfall is a 1D array of length 4 (4 rows). Each element of rainfall (rainfall[0], …, rainfall[3]) is a 1D array of length 7.
  - rainfall.length is 4
  - rainfall[i].length is 7 (for i=0,1,2 or 3)

Another example (1)

- Process the daily rainfall tabulated per month

month \ day	1 2	…	28 29 30 31
January			
February			
...			

- Number of columns: 31 for Jan, 28 for Feb, etc …
- 1st option: overdimension the array

```
double[][] rainfall=new double[12][31];
```

- 2nd option: each row has the right number of columns

```
double[][] rainfall = new double[12][];
rainfall[0] = new double[31];//January
rainfall[1] = new double[28];//February
```


Another example (2)

- Compute and print the monthly average rainfall

```
public double average(double[] a)
{
 double avg = 0;
 for (int i=0; i<a.length; i++)
   avg += a[i]/a.length;
 return avg;
}
//in some other method
for(int i=0; i<rainfall.length; i++)
 System.out.println("Month "+(i+1)+
 ": " + average(rainfall[i]));
```


2D arrays initialization

- As for 1D arrays, the default value is 0 for numbers (double, int, …), '\0' for chars, false for booleans and null for objects.
- To initialize a 2D array
  - element by element, e.g. a[2][3] = 4
  - all at once (when declaring the array)

```
int[][] a = {{1,2},{3},{1,2,3,4}};
//1st row has 2 elements: 1 and 2
// 2nd row has 1 element: 3
// 3rd row has 4 elements: 1,2,3 and 4
//a[0].length is 2, a[1].length is 1
//a[2].length is 4, a.length is 3
```

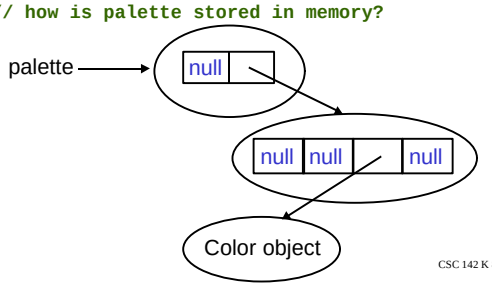
2D array of objects

- Create a game such minesweeper
- The game board is made of squares
  - Create a Square class (with methods to handle a mouse click, …)
  - Create a Game class, that has a 2D array of Squares to represent the game board.

```
//10 by 10 Squares
Square[][] gameBoard=new Square[10][10];
// Initialize the game board
for(int i=0; i<gameBoard.length; i++)
  for(int j=0; j<gameBoard[i].length; j++)
    gameBoard[i][j]=new Square();
```


Memory view of a 2D array

```
Color[][] palette = new Color[2][];
palette[1] = new Color[4];
palette[1][2] = new Color(12,18,122);//dark blue
// how is palette stored in memory?
```



Higher dimensions

- Can have arrays of any dimensions
  - think of them as array of arrays of arrays…

```
// A 4 dimensional array of integers
int[][][][] a = new int[3][4][6][8];
```

  - e.g., useful when doing mathematical computations with tensors (T_{klmn})