CS1110 1 Nov 2011: Array algorithms. 2D arrays.

Read chapter 14, pp. 385–401.

Prelim 2 is Tuesday evening, 8 November.
We will be contacting people about conflicts.

Your computer executes a single operation in about 10 billionths of a second. This is about 10^7 times shorter than the smallest time interval you can perceive.

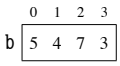
A factor of 10^7 smaller than the smallest object you can see is around 10^{-11} meters —on the order of the size of a small atom.

Powers of Ten
Ray and Charles Eames
1968
www.powersof10.com

Two-dimensional arrays

An array of **int**s (one-dimensional):

```
int[] b= new int[4];
```

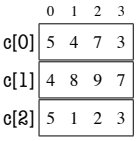


An array of **int** arrays (two-dimensional):

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

an array of (array of int)

number of columns
number of rows

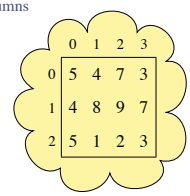


To access the elements:

```
assert c[1][2] == 9;
```

this is an array

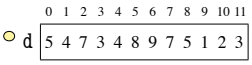
take the second element of that array



The same data as a row-major array:

```
int[] d= new int[3*4];
assert d[1*4+2] == 9;
```

common idiom "row * numCols + col"



Images in A6

An image is a 2D array of pixels. In A6 you access images via a class:

```
/** An instance maintains a row-major order array of pixels for an image. */
public class ImageArray {
    private int rows;          // number of rows in the image
    private int cols;          // number of columns in the image
    private int[] rmoArr;      // The pixels of the image, in row-major order

    public int getPixel(int row, int col) {          /** = the pixel value at [row, col]. */
        return rmoArr[row*cols + col];
    }

    public void setPixel(int row, int col, int v) {  /** Set the pixel value at [row, col] to v. */
        rmoArr[row*cols + col]= v;
    }

    public int getPixel(int p) {                     /** = pixel number p (in row major order). */
        return rmoArr[p];
    }

    public void setPixel(int p, int v) {             /** Set pixel number p (in row major order) to v. */
        rmoArr[p]= v;
    }
}
```

Note that this class lets you think of the array as a 2D array or as an "unrolled" row-major 1D array.

Steganography

Hiding character 'k' (integer representation is **107**) in a pixel:

R: 254
G: 119
B: 034

R: 25**1**
G: 11**0**
B: 03**7**

No one will ever notice, looking at the image, but your program can read it.