CS724: Topics in Algorithms
Matrices and Images (supplement)
Slide Set 3s

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Binary matrices can be used to encode black and white images in the binary format using the Image Processing toolbox. The function `imshow(A)` displays the binary image of a matrix A in a figure such that pixels with the value 0 (zero) are displayed as black and pixels with value 1 as white.

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Example

Consider the matrix $A \in \{0,1\}^{8\times 8}$ defined as

```
A = [1 0 1 0 1 0 1 0;
     0 1 0 1 0 1 0 1;
     1 0 1 0 1 0 1 0;
     0 1 0 1 0 1 0 1;
     1 0 1 0 1 0 1 0;
     0 1 0 1 0 1 0 1;
     1 0 1 0 1 0 1 0;
     0 1 0 1 0 1 0 1];
```

which represents the pattern of squares of a chess board.

The squares themselves are specified using the matrix

```
>> B=ones(50,50);
```

and the board is generated as the Kronecker product of the matrices `A` and `B`:

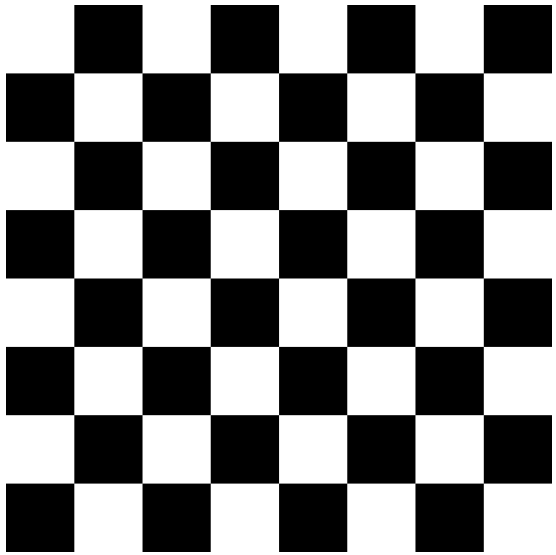
```
>> C=kron(A,B);
```

Chessboard generated in MATLAB

Using the function imshow as in

```
>> imshow(C,'Border','tight')
```

the result can be saved as a pdf file shown below:



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The `pgm` format (an acronym of "Portable Gray Map") is the simplest gray scale graphic image representation. The content of this file is shown in the next slide. On its first row `P2` identifies the file type. The digit image has been discretized in a 10×10 matrix and the format of this matrix is shown next; the next line contains the maximum gray value and the rest of the file contains the matrix $A \in \mathbb{R}^{10 \times 10}$ (having non-negative integers as entries).

A discretized representation of 4 is included in the file `four.pgm`:

```
P2
# four.pgm
10 10
16
16  16  16  16  16   4  14 16  16  16
16  16  16  14   3   3  12 16  16  16
16  16  13   1   1   3   4 16  16  16
16  14   1   2  15   4   8 16  16  16
16   8   0   2   0   0   5 16  16  16
16   3   0   0   0   0   0  6  12  16
16  16  16  16   3   3  16 16  16  16
16  16  16  16   5   5  16 16  16  16
16  16  16  16   5   9  16 16  16  16
16  16  16  16  16  16  16 16  16  16
```

The digitized representation of 4 is absorbed using

```
imdata = imread('four.pgm')
```

and is diplayed using the visualization function `imshow(imdata))`,