2D Arrays (Matrices)

- Recall: An array is a named collection of data values organized into rows and/or columns
- A 2D array is a table, called a *matrix*
- This example has 3 rows and 4 columns

	col 1	col 2	col 3	col 4
row 1	7	0	9	5
row 2	2	4	7	6
row 3	3	8	3	1

Creating a Matrix: "By Hand"

- Comma or space separates items in *same* row
- Semicolon ";" indicates a new row
- Example:

```
>> M = [7 0 5; 2 4 6; 3 8 1]

M =

   7   0   5
   2   4   6
   3   8   1
```

7	0	5
2	4	6
3	8	1

Creating a Matrix: Using a Function

- The vector-creating functions can also create matrices

```
>> M = zeros(4, 3)

M =

   0   0   0
   0   0   0
   0   0   0
   0   0   0
```

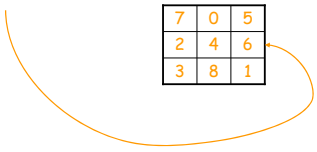
```
>> M = ones(3, 5)

M =

   1   1   1   1   1
   1   1   1   1   1
   1   1   1   1   1
```

Subscripting: Individual Entry

- Two indices are used to identify the position of a item in a matrix
  - M(r, c) refers to the item in row r, column c
  - Just like vectors, indices for matrices start at 1
  - Example: M(2, 3) refers to 6



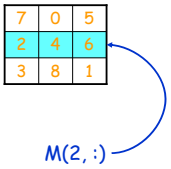
Subscripting: Entire Row

- A single colon ":" can be used to represent *all indices*

```
>> M = [7 0 5; 2 4 6; 3 8 1]
M =
   7   0   5
   2   4   6
   3   8   1

>> M(2, :)

ans =
   2   4   6
```



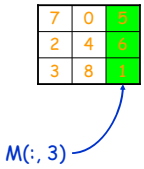
Subscripting: Entire Column

```
>> M = [7 0 5; 2 4 6; 3 8 1]

M =
   7   0   5
   2   4   6
   3   8   1

>> M(:, 3)

ans =
   5
   6
   1
```



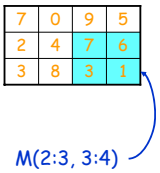
Subscripting: Subarray

```
>> M = [7 0 9 5; 2 4 7 6; 3 8 3 1]

M =
   7   0   9   5
   2   4   7   6
   3   8   3   1

>> M(2:3, 3:4)

ans =
   7   6
   3   1
```



Finding the Dimensions of a Matrix

- Matlab provides a function for this: size(M)
- Examples

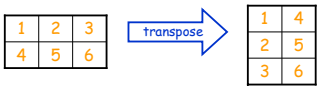
```
[nr, nc] = size(M)   % Both # of rows and # of columns
nr = size(M, 1)      % # of rows
nc = size(M, 2)      % # of columns
```

Pattern for Traversing a Matrix M

```
[nr, nc] = size(M);
for r = 1:nr
   for c = 1:nc
      % Do something with M(r, c)
   end
end
```

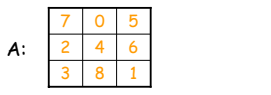
Transpose of a Matrix

- If A is a matrix then A' is the transpose of A
  - The transpose of a matrix just swaps the rows and the columns
    - An item at position (r, c) becomes an item at position (c, r)
  - Example: The transpose of [1:3; 4:6]



Finding the Maximum Value

```
m = max(A)
answer = max(m)
```



answer

or you can use iteration