Matrix (plural – Matrices)

- Store a set of values of the same type
  - *element* - value stored

- Looks like a table: it has both rows and columns

- *dimensions* - matrix with *m* rows and *n* columns is called *m x n*
  - e.g. 2 x 3 matrix:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>2</td>
</tr>
</tbody>
</table>

- *array* - refer generically to a matrix or a vector
Vectors and Scalars

- **vector** - one of the dimensions is 1
  - **row** vector with n elements is \(1 \times n\), e.g. \(1 \times 4\):

  \[
  \begin{array}{cccc}
  5 & 88 & 3 & 11 \\
  \end{array}
  \]

- **column** vector with m elements is \(m \times 1\), e.g. \(3 \times 1\):

  \[
  \begin{array}{c}
  3 \\
  7 \\
  4 \\
  \end{array}
  \]

- **scalar** - \(1 \times 1\) (a single value)

  \[
  5
  \]
Row Vectors

- $1 \times n$ vector

- Direct method: values in [ ] separated by commas or spaces

```plaintext
>> v = [1 2 3 4]
v =
 1 2 3 4
>> v = [1,2,3,4]
v =
 1 2 3 4
```

- Colon operator: iterates through values $\text{first:step:last}$
  
  e.g. $5:3:14$  --->  $5\ 8\ 11\ 14$
  
- Default step is 1
  e.g. $2:4$  --->  $2\ 3\ 4$

- Reverse
  e.g. $4:-1:1$  --->  $4\ 3\ 2\ 1$
**linspace**

- **linspace** – function creates linearly spaced vector

  \[ \text{linspace}(x, y, n) \] - \( n \) values in inclusive range from \( x \) to \( y \)

  - e.g. \( \text{linspace}(4, 7, 3) \) vector with 3 values including 4 and 7

  \[ \rightarrow [4 \ 5.5 \ 7] \]
Concatenation

- Create vectors by joining together existing vectors, or adding elements to existing vectors.

```matlab
>> v = 2:5;
>> x = [33 11 2];
>> w = [v x]
w =
     2   3   4   5   33   11   2
>> newv = [v 44]
newv =
     2   3   4   5   44
```
Elements

- **index (subscript)** - each element number:

```
   vec(4) - 4^{th} element of a vector vec above
```

- **index vector** - subset of vector using indices

```
vec( [2 4] ) - refers to 2^{nd} and 4^{th} elements of vec

vec( [1:3] ) - refers to first 3 elements
```

- Change value of element

```
vec (3) = 22
```
Column Vectors

- \( m \times 1 \) vector
- Direct method: values in [ ] separated by semicolons

\[
\gg v = [ 4 ; 7 ; 2 ]
\]
\( v = 4 \\
 7 \\
 2 
\]

- Transpose row

\[
\gg r = 2:4;
\]
\[
\gg vec = r'
\]
\( vec = 2 \\
 3 \\
 4 
\]

\( vec(2) \) - 2\textsuperscript{nd} element of a vector \( vec \) above
Matrix Variables

- $m \times n$

```matlab
>> mat = [ 1 : 3 ; 6 11 -2 ]
```

```
mat =
1  2  3
6 11 -2
```

- Separate rows with **semicolon**
- Separate within rows with **blanks or commas**
- Use any method to create a row vector. e.g. :
- **ALWAYS same number of values in every row!!**
Functions (built-in) to create matrices

- **rand(m)** creates \( m \times m \) matrix of random reals
- **rand(m,n)** creates \( m \times n \) matrix of random reals
- **zeros(m)** creates \( m \times m \) matrix of all zeros
- **zeros(m,n)** creates \( m \times n \) matrix of all zeros
- **ones(m)** creates \( m \times m \) matrix of all ones
- **ones(m,n)** creates \( m \times n \) matrix of all ones