

MATLAB treats all variables as matrices. Scalars may be thought of as 1x1 matrices, row vectors as 1xN matrices, and column vectors as Nx1 vectors. Matrices are defined by placing values within square brackets. To define a row matrix, separate the values by spaces or commas. To define a column vector separate the values by semicolons. Larger matrices, such as the 3x2 matrix in the last example are defined by separating the rows of numbers by semicolons.

Scalar (1x1 matrix)

```
>> Bob = 10

Bob =

    10
```

Row Vector (1x4 matrix)

```
>> x = [1 2 3 4]

x =

     1     2     3     4
```

Column Vector (3x1 matrix)

```
>> y = [2; 4; 6]

y =

     2
     4
     6
```

3x2 matrix

```
>> a = [0 1; 2 3; 4 5]

a =

     0     1
     2     3
     4     5
```

Vectors with equally spaced entries may be defined using the **colon operator**. When a single colon is used, the vector entries are separated by unity. When two colons sandwich a third parameter, the middle parameter sets the increment (see the examples below). The last example shows how to create a column vector using the **transpose operator** `'`. The transpose operator may be applied directly to existing operators as well (for example if `b = a'` then matrix `b` will equal the transpose of matrix `a`).

```
>> a = [3:7]

a =

     3     4     5     6     7
```

```
>> y = [2; 0.5; 4]

y =

     2     2.5     3     3.5     4
```

```
>> y = [4; -0.5; 2]

y =

     4     3.5     3     2.5     2
```

```
>> a = [0:2]'
```

```
a =

     0
     1
     2
```

To extract a single element or a group of elements from a matrix, use **parentheses**. MATLAB indexes matrix elements starting a 1, so the first element of an row vector `a` is `a(1)`, the second is `a(2)`, etc. (see the first example). A group of elements may be extracted using the **colon operator**. For example, `a(2:4)` extracts the 2nd, 3rd, and 4th elements. A pair of indices must be used to extract an element from a NxM matrix. The next example shows how the second element of the first row of a 2x3 matrix is referenced. In the last example, the colon operator is used by itself to extract an entire column (the second column in this example)

```
>> a = [3:7]

a =

     3     4     5     6     7

>> a(2)

ans =

     4
```

```
>> a = [3:7]

a =

     3     4     5     6     7

>> a(2:4)

ans =

     4     5     6
```

```
>> a = [0 1 2; 3 4 5];

a =

     0     1     2
     3     4     5

>> a(2, 3)

ans =

     5
```

```
>> a = [0 1 2; 3 4 5]

a =

     0     1     2
     3     4     5

>> a(:, 2)

ans =

     1
     4
```