

## Lesson One Student Notes

A matrix is a rectangular array of numbers.

Special meaning is sometimes attached to 1-by-1 matrices, which are scalars, and to matrices with only one row or column, which are vectors.

The basic conventions for entering matrices are—

Separate the elements of a row with blanks or commas.

Use a semicolon, ; , to indicate the end of each row.

Surround the entire list of elements with square brackets, [ ].

[2,3,4] in MATLAB is a 1 by 3 matrix also referred to as a row vector.

[2;3;4] in MATLAB is a 3 by 1 matrix also referred to as a column vector.

When you do not specify an output variable, MATLAB uses the variable ans, short for answer, to store the results of a calculation.

The transpose operation is denoted by an apostrophe or single quote, '. The transpose operation flips a matrix about its main diagonal and turns a row vector into a column vector.

The MATLAB operation `sum(A)'` produces a column vector containing the row sums.

Use the Help Navigator index to find the help information for `diag [1] [2]`. Read that information then answer the questions:

What would `diag([1,2;3,4])` return? [1;4]

What would `diag([1,2;3,4],1)` return? [2]

What would `diag([1,2,3])` return? [1, 0, 0; 0, 2, 0; 0, 0, 3]

What would `diag([1,2,3],-1)` return? [0, 0, 0; 1, 0, 0; 0, 2, 0; 0, 0, 3]

Now continue with the help section: "sum, transpose, and diag"

### Subscripts

In the computer language C+, row and column subscripts start with 0, in FORTRAN subscripts start with 1, in MATLAB subscripts start with 1.

The element in row i and column j of A is denoted by A(i,j).

Suppose B is the MATLAB matrix [1, 2, 3; 6, 5, 4; 7, 8, 9]

What would be the value of the following:

MATLAB reference	value
B(1,1)	1
B(3,3)	9
B(4)	2
B(9)	9
B(0,0)	error
B(3,4)	error

## Colon Operator

The row vector  $[m, m+1, m+2, \dots, n]$  can be generated in MATLAB with the colon operator as follows:  $m:n$ .

The row vector  $[m, m+i, m+2i, \dots, n]$  can be generated in MATLAB with the colon operator as follows:  $m:i:n$ .

Fill in the table below:

MATLAB reference	value
1:5	[1, 2, 3, 4, 5]
1:4:17	[1, 5, 9, 13, 17]
-1 : 3 : 26	[-1, 2, 5, ...26]
diag(1:3)	[1, 0, 0; 0, 2, 0; 0, 0, 3]
sum(1:9)	45
0: 0.5 :3	[0, 0.5, 1, 1.5, 2, 2.5, 3]

Suppose B is the MATLAB matrix [1, 2, 3, 11; 6, 5, 4, 12; 7, 8, 9, 13], fill in the table below:

MATLAB reference	value
B(1:2,3)	[3; 4]
B(:,2)	[2; 5; 8]
B(end,2)	[8]
B(2:3,end)	[12; 13]
B(2,1:2:4)	[6, 4]
B(1:5:10)	[1, 8]

To exchange the last two columns of B we could use  $[B(:,1)'; B(:,2)'; B(:,4)'; B(:,3)']'$  or  $B(:,[1,2,4,3])$

## Expressions

In MATLAB expressions involve entire matrices.

The building blocks of expressions are variables, numbers, operators, and functions.

Variable names consist of a letter, followed by any number of letters, digits, or underscores. MATLAB uses only the first 31 characters of a variable name. MATLAB is case sensitive; that means that it distinguishes between uppercase and lowercase letters.

To view the matrix assigned to any variable, simply enter the variable name.

Specify the following number MATLAB acceptable notation:

MATLAB reference	value
6.02221367e23	$6.02221367 \times 10^{23}$
6.6260755e-27	$6.6260755 \times 10^{-27}$
1.672631e-24	$1.6726231 \times 10^{-24}$
5780	5780
2i or 2j	$\sqrt{-4}$
-2.1798741e-11	$-2.1798741 \times 10^{-11}$

Floating-point numbers have a finite precision of 52 binary bits which is roughly 16 significant decimal digits and a finite range of  $2^{\pm 1024}$  or roughly  $10^{-308}$  to  $10^{+308}$ . MATLAB operators operate on matrices. In addition to the common operators +, -, \*, /, and ^; we also have \ for matrix left division, .' for array transpose, and ' for complex conjugate transpose.