M241-MATLAB (P. Staley) Lesson Two

Working with Matrices and Arrays

Do the following:
1. Open MATLAB, choose MATLAB Help to open the help window, choose "Matrices and Arrays" from the content tab of the Help Navigator Window.

2. Read and study the "Working with Matrices" section. As a guide for study, fill out the student notes portion below.

3.1[1] Use a text editor to create a text file for the matrix:

$$\begin{bmatrix} 0.70 & 0.15 & 0.15 \\ 0.20 & 0.80 & 0.15 \\ 0.10 & 0.05 & 0.70 \end{bmatrix}$$

Save the text file as P.dat
3.2 From MATLAB load the matrix into the P matrix.
3.3 Compute the matrix products

$$P\begin{bmatrix} 15{,}000 \\ 20{,}000 \\ 65{,}000 \end{bmatrix}, \quad P^2\begin{bmatrix} 15{,}000 \\ 20{,}000 \\ 65{,}000 \end{bmatrix}, \quad P^5\begin{bmatrix} 15{,}000 \\ 20{,}000 \\ 65{,}000 \end{bmatrix}, \quad \text{and} \quad P^{10}\begin{bmatrix} 15{,}000 \\ 20{,}000 \\ 65{,}000 \end{bmatrix}$$

3.4 Print out a clean version of the Command window showing the results from step 3.3.

4. Use the MATLAB text editor to create a file containing the command window commands from steps 3.2 and 3.3 above. Save the file as larsonE4.m. Go back to the command window and invoke the M-file with
LarsonE4
print the command window results and turn them in.

5. Read the Linear Algebra Definitions document on the www.staley-classes.org website and answer the questions in the Lesson two notes below.

6. Read and study the "More About Matrices and Arrays" section of the MATLAB Help. As a guide for study, fill out the student notes portion below.

Exam Two is based on the material on these pages. Let your instructor know when you are ready to take exam two.

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[1] If you are in the Linear Algebra class you will find the computations in item 3 correspond to the consumer preference model from the Larson Intro to Linear Algebra 4th ed. (examples 2 and 3 from section 2.5).

Lesson Two Student Notes

Working with Matrices

MATLAB provides four functions that generate basic matrices. They are

_____, _____, _____, and

_____.

The MATLAB function call that creates an n-by-n array filled with zeros is

_____.

The MATLAB function call that creates an m-by-n array filled with zeros is

_____.

The MATLAB function call that creates an array filled with zeros with the same dimensions as matrix A is _____.

The MATLAB function call that creates an n-by-n array filled with ones is

_____.

The MATLAB function call that creates an m-by-n array filled with ones is

_____.

The MATLAB function call that creates an array filled with ones with the same dimensions as matrix A is _____.

The _____ function generates arrays of random numbers whose elements are uniformly distributed in the interval _____.

_____ will generate an n-by-n array of uniformly distributed random numbers in the range _____.

_____ will generate an m-by-n array of uniformly distributed random numbers in the range _____.

_____ will generate an array of uniformly distributed random numbers that has the same dimensions as the matrix A.

The _____ function generates arrays of random numbers whose elements are normally distributed with mean _____ and standard deviation _____.

_____ will generate an m-by-n array of _____ distributed random numbers with mean ____ and standard deviation ____.

The **load function** reads _____ files containing matrices generated by earlier MATLAB sessions, or reads _____ files containing numeric data. The text file should be organized as a rectangular table of numbers, separated by _____, with one _____ per line, and an equal number of elements in each _____.

You can create your own matrices using M-files, which are text files containing _____ _____. Use the MATLAB Editor or another text editor to create a file containing the same statements you would type at the _____ _____ _____. Save the file under a name that ends in _____.

_____ is the process of joining small matrices to make bigger ones. The pair of _____, is the _____ operator.

For example: if P is the matrix

$$\begin{bmatrix} 0.70 & 0.15 & 0.15 \\ 0.20 & 0.80 & 0.15 \\ 0.10 & 0.05 & 0.70 \end{bmatrix}$$

Then [P-eye(3), zeros(3,1)] would be the ____ by ____ matrix:

You can delete a rows or columns by assigning them to ____.

For example if we start A as the matrix:

$$A = \begin{bmatrix} -0.3 & 0.15 & 0.15 & 0 \\ 0.20 & -0.2 & 0.15 & 0 \\ 0.10 & 0.05 & -0.3 & 0 \end{bmatrix}$$

then

A (: , end) = []

leaves A as

A =

If we continue the assignment to ____ using only a single subscript then the operation behaves as if the original matrix is first reshaped into a _____. So that with A as previously

A([1, 5,9]) = []

now leaves

A =

Linear Algebra Notes

The **matrix multiplication** A B requires that the number of _____ in A must be the same as the number of _____ in B, i.e. if A is m-by-p the B must be ____ by ____. Alternately we could say that the length of the _____ of A must be the same as the length of the _____ of B. The result of multiplying an m-by-p matrix A times a ___-by-n matrix B is an ____ by ____ matrix C in which the (i,j) element is the sum of

the _____ of the elements of the _____ of A and the j_____ of B. For example

$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} * \begin{bmatrix} 5 \\ 6 \end{bmatrix}$ yields the ___ by ___ product

Matrix multiplication is not commutative, i.e. generally A*B B*A.

The common method of **solving a system of linear equations** is to write the augmented matrix for the system and then use elementary row operations to reach an equivalent system of equations in _____. This method is called the Gauss-Jordan elimination method. The MATLAB function that does the reduction to _____ form is _____. The solutions to the system of equations can be read from the _____ form.

The **inverse of a square matrix** A is a matrix B for which _____ where I is the_____ matrix. If a square matrix A has an inverse we call it invertible or _____ otherwise it is _____ or noninvertible. The inverse matrix can also be used to solve systems of equations:

If A*X = C and A is an n by n invertible matrix then X = B*C where B is the inverse of A.

If square matrix A has a _____ λ and a _____ X for which

$A*X = \lambda X$

Then we say λ is an _____ for A with the associated _____ X.

For example: if P is the matrix

$\begin{bmatrix} 0.70 & 0.15 & 0.15 \\ 0.20 & 0.80 & 0.15 \\ 0.10 & 0.05 & 0.70 \end{bmatrix}$

and X is the vector $\begin{bmatrix} 7000 \\ 10000 \\ 4000 \end{bmatrix}$

then P*X is $\begin{bmatrix} 7000 \\ 10000 \\ 4000 \end{bmatrix}$ = X

so _____ is an _____value of P with corresponding _____ $\begin{bmatrix} 7000 \\ 10000 \\ 4000 \end{bmatrix}$.

More About Matrices and Arrays

Matrix operations from Linear Algebra

_____ returns the determinant of the square matrix A.

_____ returns the matrix that is row equivalent to A and is in reduced row echelon form.

_____ returns the inverse matrix of a nonsingular matrix A.

_____ returns a column vector of the eigenvalues of square matrix A.

[name1, name2] = eig(A) returns the _____ as the columns of name1, and the corresponding _____ as the diagonals of the diagonal matrix name2.

Array Operator Notes

Arithmetic operations on arrays are done _____ by _____. This means that addition and subtraction are the same for arrays and matrices, but that multiplicative operations are different. MATLAB uses a _____, as part of the notation for multiplicative array operations. The list of array operators includes

+	Addition
-	Subtraction
	Element-by-element multiplication
	Element-by-element division
	Element-by-element left division
	^Element-by-element power
	Unconjugated array transpose

Suppose n is the column vector n = (0:3)';

Then pows = [n n.^2 2.^n]

builds the table:

The elementary math functions operate on arrays element by element.

x = (1:0.1:2)';

logs = [x log10(x)]

builds a _____ of logarithms.

Matrices and scalars can be combined in several different ways. For example, a scalar is subtracted from a matrix by subtracting it from each element.

With **scalar expansion**, MATLAB assigns a specified scalar to all indices in a range. For example, B(1:2,2:3) = 0 has the effect of

_____.

Logical Subscripting

The logical vectors created from logical and relational operations can be used to reference _____. Suppose X is an ordinary matrix and L is a matrix of the same size that is the result of some _____ operation. Then X(L) specifies the elements of X where the elements of L are _____.

The find Function

The find function determines the _____ of array elements that meet a given logical condition. In its simplest form, find returns a _____ vector of _____. Transpose that vector to obtain a row vector of _____.