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%  Matlab_intro:   A Matlab tutorial for Linear Algebra                (Matlab for LinAlg-1/2)
%  ------------------------------------------------------------
%           The lines that start with the percent sign are comments.
%           You don't have to type them.  Matlab ignores anything after a %.

% Windows
% When you start up Matlab you will see a window with many panes.  I will call each a window.
% You can move them around and resize them in very flexible ways.  First let's look at

%%%%%%%%%%%%%%%%%% The Command Window
% This is where you type the command you want Matlab to perform.  Try
2+2
x=[1 1]           % space or comma between numbers creates a row vector.
x=[1; 1]          % semi-colon creates a column vector
A=[1 2; 3 4]      % combine spaces and semi-colons to make matrices
B=eye(2)          % This is a cute way to spell the identity matrix
y=1:9             % colon creates a list of numbers (row vector)
z=0:.25:4         % You can step the list by non-integers
z(3:8)            % you can use lists to access part of a vector
z(8:-1:3)         % you can reverse the order by stepping by negative amounts.

% Formating of numbers
format long                % how many digits to print
[1 1.25 pi]
format short
[1 1.25 pi]
format compact             % how much space between lines
[1 1.25 pi]
format loose
[1 1.25 pi]
%Set these permanently for you on this machine using the menu:  MATLAB->Preferences->Command Window
%I suggest format compact and format short for now.  Sometimes you might need format long.


% Matrix operations
A+B
2*A
A*B
B*A

C=[1 1;1 0]      % What should C*A equal? (think of 2 row combinations, or 4 dot products)
% Now try it
C*A
% Check if the order of multiplication matters.
A*C
% What did multiplying on the right by C do to the columns of A? (which 2 column combinations)

% Manipulating Matrices
A'          % this is called a transpose.  What did it do to A?
A(1,1)=5
A(2,1)=7
A(:,1)=[1 3]      % Notice that Matlab figures out to change the row on the RHS to a column in A

C=rand(4,4)     % create a matrix of random numbers uniformly likely between 0 and 1
C(2:3, 2:3) = A % What will this do?
C(3,:)          % What part of C is this?
C(:,3)          % What part of C is this?

D=zeros(4,2)
BIG= [ A D'; D C]        % Make a "Block Matrix"   Why do we need the ' symbol?
BAD= [A D;D C]         % What error shows if we don't have the transpose?

A*A
A^2
A^2+D'*D          % This is the first "block row" times first "block column" of BIG*BIG
BIG*BIG       % Check that the first "block entry" of BIG*BIG matches the previous line.
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%%%%%%%%%%%%%%%%%%%%  The Workspace Window                          (Matlab for LinAlg-2/2)
% This window pane shows the variables that have been defined in this Matlab Session.
% You can also examine and edit these variable with a spreadsheet interface.
% Try double clicking on BIG and change its last entry to 4.
B(6,6)        % this should show up as 4 now
% This window turns out to be not very useful except for entering/checking your data.
% You can choose to remove it from the visible panes using the "X" in the upper right.
% You can also separate any pane into its own window using the arrows at the top of the pane.
% Separate and then put back the command window.

%%%%%%%%%%%%%%%%%%%%  The Current Folder Window
% This window lets you see and manipulate the files you are using.
% The command window has a "Current Folder" associated with it.  Any files in this Folder
% ending in .m are available as commands in Matlab.

% Switch Folders to your Desktop.  You can use the mouse, or in the command window tyope
cd ~/Desktop      % the ~ symbol is a shortcut to /Users/yourname/
% Start editing a file   (you can use the mouse to open a "New Script File" or in the command
% window type:
edit myscript.m

% In this file type the following commands
A=[1 2; 3 4]
b=[1;1]
x=A\b          % notice that this is a backwards division symbol
               % meaning that A is on the left AND in the denominator.
               % Multiplying on the RIGHT by A inverse is written /A
% Save the file as myscript.m
% Now in the command window:
myscript            % you can see all the output

% Go back to the file and put a semicolon after the first two lines.  It should look like
A=[1 2; 3 4];
b=[1;1];
x=A\b
% Now when you run the script it will not print the output of the first two lines.
%  SEMI-COLON AT THE END OF THE LINE TURNS OFF PRINTING THE OUTPUT OF THAT LINE

% Solving Systems of Linear Equations
% Create a script (call it tut1.m) and enter the matrix A and right hand side b
% and then solve for x.  Only allow the solution to be printed.

%   3x + 4y - z = 4
%   2x - 2y + 4z= 2
%  0.5x+ 3y _ z = -2

% Run it in the command window to debug the script.  Check the answer in the command window:
A*x-b
% For a big system of equations instead of printing all the differences, you can check
% if any are not zero using the "any" command
any(A*x-b)      % should return 0 if all are zero.  1 if any are not zero.

%%%%%%%%%%%%%%%%%%%%%%%%%%  More Files
% Download the scripts rowpicture.m, columnpicture.m, and arrow.m
% from our webpage http://math.colgate.edu/math214
% Move them from the Downloads folder to your Current Folder (probably the Desktop).
% Read the files rowpicture.m and columnpicture.m in the editor.
% Use them to draw the pictures for the above system of equations.
%%%% Row Picture
% You can embed the figure window with the rest by using the arrow at the top of the figure.
% Click on the icon with a circular arrow to spin the image in 3-D and see all angles.
% Can you see a line of intersection for 2 planes?  Does it intersect the 3rd plane?
%%%% Column Picture
% Can you see that the blue arrows are each parallel to one of the green arrows?
% If you change the last entry of b from -2 to 2, why do only 2 blue arrows show up?
```