

## Matlab Notes Fall 2009

1. Case sensitive
2. Type variable to get value
3. Parens, brackets, braces different
4. Scroll with up, down arrows
5. Defining matrices:  $A = [1\ 2; 3\ 4]$  is  $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$
6. Use ; at end to suppress output
7. A row vector is created using  $x = [1\ 2\ 3\ 4]$ . A column vector is created using  $y = [1; 2; 3; 4]$
8. Use space or comma to separate elements in a row, use ; or return to separate rows
9. For matrix addition use +, for matrix mult and scalar mult use \*
10. transpose is '
11. Creating matrices of all ones, all zeros, random matrices or identity matrices: ones(3), zeros(3), eye(3), rand(3) or ones(3,2), rand(3,2). Note: for random matrices, the values are uniformly distributed on the interval [0,1]
12. To create random integer matrices, with uniformly distributed integers on [0,9] use  $\text{floor}(10 * \text{rand}(3,2))$  (to get a  $3 \times 2$  matrix)
13. To create random integer matrix with positive and negative values (uniformly distributed on [-10,9], you could use  $\text{floor}(20 * (\text{rand}(3,2) - 0.5))$
14. Inner product of row vectors  $a$  and  $b$  use  $a * b'$ ; for column vectors use  $a' * b$ ; or for either case use  $\text{dot}(a,b)$
15. For outer product of row vectors use  $a' * b$ ; for column vectors use  $a * b'$
16. Dot notation: .^and .\* for element-by-element operation (for matrices of same size or if one is a scalar)
17. To create equally spaced row vectors use:  $a=0:0.1:1$  or  $a=\text{linspace}(0,1,11)$
18. Can create graph of a function:  $x=0:0.1:1$  and  $y=\sin(x)$  or  $y=x.^2$  then  $\text{plot}(x,y)$
19. To graph both  $\sin(x)$  and  $x.^2$  use  $x=0:0.1:1$  and  $y1=\sin(x)$  and  $y2=x.^2$  then  $\text{plot}(x,y1,x,y2)$
20. Math functions apply to each element (but ^ is not a math function, it's a matrix function)
21. i for complex; conj for complex conjugate; ' is hermitian transpose
22. trace is trace
23. norm is norm
24. triu(A) is upper triangular part, tril(A) is lower triangular part
25. triu(A,n) is part above nth diagonal, tril(A,-n) is part below -nth diagonal
26. A(i,j) is the element in row i, col j
27. Inverse of A is  $\text{inv}(A)$  or  $A^{-1}$
28. The solution to  $Ax = b$  can be written in Matlab as  $x = A \setminus b$ . Note: be careful with this one! It solves systems that cannot be solved! More later.
29. Another way to solve  $Ax = b$  is to form the augmented matrix  $C = [A\ b]$  and then use  $\text{rref}(C)$  (rref for reduced row echelon form). This method works even when the matrix A is singular (ie,  $\det(A) = 0$ ).
30. You can construct block matrices in Matlab. If  $A, B, C, D$  are matrices, then  $[A\ B; C\ D]$  is a block matrix as long as rows, columns are compatible. You can create augmented matrices this way.

31. More on  $A(i,j)$  notation.  $A(1,2)$  gives element in row 1, col 2.  $A(1,2 : 4)$  gives the 2nd through 4th elements of row 1.  $A(1,:)$  gives all of row 1,  $A(:,2)$  gives all of column 2.  $A([1\ 3],:)$  is a new matrix consisting of rows 1 and 3.

32. One way to switch rows 1 and 3 is  $A([1\ 3],:) = A([3\ 1],:)$ . To multiply row 3 by 5 use  $A(3,:) = 5 * A(3,:)$ . To multiply row 1 by 3 and add to row 2 use  $A(2,:) = 3 * A(1,:) + A(2,:)$ .

33.  $diag([1\ 2\ 3])$  is diagonal matrix  $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ . If  $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$  then  $diag(A)$  is the

column vector  $\begin{bmatrix} 1 \\ 5 \\ 9 \end{bmatrix}$

34. `syms a b` tells matlab to treat  $a$  and  $b$  as symbolic variables. Then symbolic commands like `diff`, `int`, `simplify`, `factor`, `expand` can be used along with  $a$  and  $b$ . For example `diff(a * b^2, b)` results in  $2 * a * b$  and `factor(a^2 - b^2)` results in  $(a - b) * (a + b)$ .

35. To save a Matlab session type “diary filename.txt” at the beginning of the session to save the session in the file filename.txt. Type “diary off” at the end of the session.

36. If you forget to use the diary command to save your session, your commands should still be saved in the Command History window. Create a new .m file with “File New M-File”, use Shift-click to highlight all the commands you want to save, drag the commands to the editor window, and save with a .m extension. This saves only the commands, but you can run the entire .m file as a script file, and re-create your session.