Relevant Matlab Commands

1. At any time, you can get help on any Matlab command by typing help and then the command name (e.g. help matrix will pull up help on entering matrices)

2. You can enter matrices in matlab as follows: type $x = [2\ -3\ 4]$ for the 1×3 matrix [2 -3 4]; x can also be thought of as a 3-d vector.

3. Here is a 2×3 matrix: A=[3 4 -1; 6 -4 5], which produces the following matrix
$$A = \begin{pmatrix} 3 & 4 & -1 \\ 6 & -4 & 5 \end{pmatrix}$$
Note the semicolon ; separates the rows.

4. $A(i,j)$ is the i,jth entry of A; so for the above matrix, $A(2,2) = -4$. Also $A(:,1)$ is the first column of A; $A(2,:)$ is the second row of A; $A(:,1:2)$ is the first two columns of A

5. Operations on matrices:

   - $A+B$, $A-B$ add and subtract the matrices (of the same dimension)
   - r*A multiplies each entry of A by r.
   - $A * B$ multiplies two matrices
   - A^n multiplies A by itself n times
   - $inv(A)$ computes the inverse of A
   - A' computes the transpose of A
   - $\det(A)$ computes the determinant of A (for square matrices only)
   - $trace(A)$ computes the trace of A
   - Solving $Ax = b$ for x can be done in Matlab with the command $x = A\backslash b$; this is like taking b “divided by” A from the left (which is how to remember the syntax), but Matlab is really solving $Ax = b$ by using row operations as in chapter 1.
   - rref(A) will produce the reduced row echelon form of A; this command zeros out elements both above and below the diagonal and is useful for finding pivots and free variables.

- If A is an $n \times m$ matrix and u is an $1 \times m$ matrix (an m-vector), then $[A;\ u]$ adds the vector u to the bottom of A; for example - let

$$A = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad u = [5\ 6\ 7] \ \text{ then } \ [A; u] = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 5 & 6 & 7 \end{pmatrix}$$

- If v is a column vector of dimension m, then $[A\ v]$ augments A by attaching v to the last column of A; this is useful for forming augmented matrices. For example, if A is as above and

$$v = [2\ 4\ 6]' = \begin{pmatrix} 2 \\ 4 \\ 6 \end{pmatrix} \quad \text{then } \ [A\ v] = \begin{pmatrix} 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & 4 \\ 0 & 0 & 1 & 6 \end{pmatrix}$$

6. Special Matrices:

   - eye(m,n) is an $m \times n$ matrix with ones on the diagonal
   - zeros(m,n) is an $m \times n$ matrix of zeros
   - rand(m,n) is an $m \times n$ matrix of random numbers
   - diag(v) generates a diagonal matrix with the entries of the vector v along the diagonal
   - diag(A) extracts the diagonal of the matrix A as a vector.

7. $lu(A)$ will return the LU decomposition of the matrix A; U will be upper triangular and L will be a pivoted lower triangular matrix (i.e. L will be modified by any pivoting performed by Matlab).

8. If X and Y are vectors of the same length, then $dot(X, Y)$ computes their dot product.

9. For a vector X, $norm(X, p)$ computes the l^p norm of X

10. $[V, D] = eig(A)$ produces a diagonal matrix D consisting of the eigenvalues of A and a matrix V with the corresponding eigenvectors (so $A * V = V * D$).

11. $null(A)$ gives a basis of the null space of the matrix A; $rank(A)$ is the rank of A;

12. $[Q, R] = qr(A)$ produces an orthogonal (or unitary) matrix Q and an upper triangular R with $A = Q * R$