Helwan University
Faculty of Computers and Information

Assignment

Department of Computer Science
Linear Algebra

1. Let A and B be $m \times m$ symmetric matrices. Show that AB is symmetric if and only if $AB = BA$.
2. Prove that if A is an $m \times n$ matrix then $\text{tr}(A'A) = 0$ if and only if $A = \mathbf{0}$.
3. Show that if x and y are $m \times 1$ vectors, $\text{tr}(xy') = x'y$.
4. Expand the quadratic form $x'Ax$ algebraically and find the coefficient of each term. How the coefficients change if A is symmetric?
5. For each of the following, find the 3×3 symmetric matrix A so that the given identities hold:
   (a) $x'Ax = x_1^2 + 2x_2^2 - x_3^2 + 4x_1x_2 - 6x_1x_3 + 8x_2x_3$.
   (b) $x'Ax = 3x_1^2 + 5x_2^2 + 2x_3^2 + 2x_1x_2 + 2x_1x_3 + 4x_2x_3$.
   (c) $x'Ax = 2x_1x_2 + 2x_1x_3 + 2x_2x_3$.