EE2302 Foundations of Information and Data Engineering

Assignment 7 **Due: 11 pm, Nov 4**

Full Mark: 16 points

1. (6 points) Suppose the 100-vector x represents the distribution of ages in some population of people, with x_i being the number of $i - 1$ year olds, for $i = 1, \ldots, 100$. (You can assume that $x \neq 0$, and that there is no one in the population over age 99.) Find expressions, using vector notation, for the following quantities.
   a) The total number of people in the population.
   b) The total number of people in the population age 18 or above.
   c) The average age of the population.

   Your answers should be expressed in terms of vectors, without using summations of individual components of a vector. If necessary, you may define new vectors.

2. (6 points) Let x be a real n-vector and define y as the real, non-negative vector (i.e. the vector with non-negative real entries) closest to x.
   a) Give an expression for each element of y.
   b) Show that $z = y - x$ is also a non-negative vector.
   c) Show that $z^T y = 0$.

3. (4 points) By choosing the right vector b in the Cauchy-Schwarz inequality, prove that
$$(a_1 + a_2 + \cdots + a_n)^2 \leq n(a_1^2 + a_2^2 + \cdots a_n^2).$$