

## Vector Equations

An equation in the form  $x_1\mathbf{a}_1 + x_2\mathbf{a}_2 + \dots + x_n\mathbf{a}_n = \mathbf{b}$  is called a **vector equation**. Please be careful, to differentiate between the scalars  $\alpha_1, \alpha_2, \dots, \alpha_p$ , and the column vectors  $\mathbf{a}_1, \mathbf{a}_2, \dots, \mathbf{a}_n$ .

A vector equation has the same solution set as the linear system whose augmented matrix is  $\left[ \begin{array}{cccc} \mathbf{a}_1 & \mathbf{a}_2 & \cdots & \mathbf{a}_n & \mathbf{b} \end{array} \right]$ .

In particular,  $\mathbf{b}$ , can be generated by a linear combination of  $\mathbf{a}_1, \mathbf{a}_2, \dots, \mathbf{a}_n$  if and only if there exists a solution to the linear system corresponding to  $\left[ \begin{array}{cccc} \mathbf{a}_1 & \mathbf{a}_2 & \cdots & \mathbf{a}_n & \mathbf{b} \end{array} \right]$ .