# Coordinates of Vectors

Previously we saw that you can express a vector in terms of a basis in exactly one way. Let us formalize that idea now.

**Definition:** An **ordered basis** $F = (f_1, f_2, ..., f_n)$ of a vector space $V$ is a basis whose members have been ordered from first to last in some way (as indicated here by the subscripts). Let $v$ be a vector in $V$. Then there are **unique** coefficients $a_1, a_2, ..., a_n$ such that

$$v = a_1 f_1 + a_2 f_2 + \cdots + a_n f_n$$

We call the $a_i$'s the coordinates of $v$ relative to the basis $F$ and adopt the notation

$$[v]_F = \begin{bmatrix} a_1 \\ \vdots \\ a_n \end{bmatrix}$$

**Note:** Even though a vector can be something rather exotic (a polynomial, a digital image, etc.), its coordinate vector relative to a basis **is always a column vector**.