

$$a+b = \begin{pmatrix} 3 \\ 3 \\ 5 \end{pmatrix}$$

$$|b| = \sqrt{2^2 + 1^2 + 2^2} = 3$$

$$|b|a = 3a = \begin{pmatrix} 3 \\ 6 \\ 9 \end{pmatrix}$$

$$Ma = \begin{pmatrix} 1 & 0 & 1 \\ 2 & 1 & 0 \\ 3 & 0 & 2 \end{pmatrix} \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} = \begin{pmatrix} 1 \times 1 + 0 \times 2 + 1 \times 3 \\ 2 \times 1 + 1 \times 2 + 0 \times 3 \\ 3 \times 1 + 0 \times 2 + 2 \times 3 \end{pmatrix} = \begin{pmatrix} 4 \\ 4 \\ 9 \end{pmatrix}$$

$$MN = \begin{pmatrix} 1 & 0 & 1 \\ 2 & 1 & 0 \\ 3 & 0 & 2 \end{pmatrix} \begin{pmatrix} 0 & 1 & 0 \\ -1 & 1 & 1 \\ -1 & 3 & -1 \end{pmatrix}$$

$$= \begin{pmatrix} -1 & 4 & -1 \\ -1 & 3 & 1 \\ -2 & 9 & -2 \end{pmatrix}$$

$$a \times b = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \times \begin{pmatrix} 2 \\ 1 \\ 2 \end{pmatrix} = \begin{pmatrix} 2 \times 2 - 3 \times 1 \\ -1 \times 2 + 2 \times 3 \\ 1 \times 1 - 2 \times 2 \end{pmatrix} = \begin{pmatrix} 1 \\ 4 \\ -3 \end{pmatrix}$$

$$a \cdot b = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \cdot \begin{pmatrix} 2 \\ 1 \\ 2 \end{pmatrix} > 0 \quad \text{angle less than } 90^\circ$$

$$b_a = \frac{a \cdot b}{a \cdot a} a = \frac{\begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \cdot \begin{pmatrix} 2 \\ 1 \\ 2 \end{pmatrix}}{\begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \cdot \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}} \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} = \frac{5}{7} \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$$

$$c = |b - b_a| = \left| \begin{pmatrix} 2 \\ 1 \\ 2 \end{pmatrix} - \frac{5}{7} \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \right| = \left| \frac{1}{7} \begin{pmatrix} 9 \\ -3 \\ -1 \end{pmatrix} \right| = \sqrt{13}$$