Introduction

• Cardinal Rule: If you don’t understand something, ask a question, as it will probably do more good than sitting in your seat thinking ”Man, I don’t understand ANYTHING this guy is saying!”

Dot Products

• The dot product is large when the size of the vectors are large and the vectors are close to being parallel.

• If vectors $\mathbf{a}, \mathbf{b}$ are perpendicular, $\mathbf{a} \cdot \mathbf{b} = 0$

• If vectors $\mathbf{a}, \mathbf{b}$ are parallel, $\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}|$
• The above two statements can be conflated to the overall rule: \( \mathbf{a} \cdot \mathbf{b} = |\mathbf{a}| |\mathbf{b}| \cos(\theta) \), where \( \theta \) is the angle between the vectors.

• If \( \mathbf{a}, \mathbf{b} \) are in cartesian co-ordinates, \( \mathbf{a} = \langle w, t, u \rangle, \mathbf{b} = \langle f, g, h \rangle \), then \( \mathbf{a} \cdot \mathbf{b} = wf + tg + uh \).

Cross Products

• For vectors \( \mathbf{a}, \mathbf{b} \), the length of the cross product \( \mathbf{a} \times \mathbf{b} \) is the area of the parallelogram determined by the vectors \( \mathbf{a} \) and \( \mathbf{b} \). This length also happens to equal \( |\mathbf{a}| |\mathbf{b}| \sin(\theta) \).

• The cross product of \( \mathbf{a} \) and \( \mathbf{b} \) is always perpendicular to both \( \mathbf{a} \) and \( \mathbf{b} \).
• The direction of the cross product is given by the right hand rule.

• The cross product of the vectors $\langle a, b, c \rangle$ and $\langle d, e, f \rangle$ can be calculated by taking the determinant of the matrix

$$\begin{vmatrix}
i & j & k \\
a & b & c \\
d & e & f \\
\end{vmatrix}$$