German University in Cairo
Media Engineering and Technology
DMET 502 Computer Graphics, Winter 2023
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Practice assignment 1

Math Basics

Q 1: Normalize the vector: $[7, 3, 6]^T$

Q 2: Suppose that two 3D line segments are extended from $[1, 5, 0]^T$ to $[2, 3, 0]^T$ to $[4, 4, 0]^T$. What is the angle between them at $[2, 3, 0]^T$?

Q 3: Suppose that two 3D line segments are extended from $[1, 5, 0]^T$ to $[2, 3, 0]^T$ to $[4, 4, 0]^T$. Without calculating its value, determine whether the angle between these lines is acute or obtuse.

Q 4: Suppose that two 3D line segments are extended from $[0, 0, 0]^T$ to $[3, 3, 0]^T$, and from $[2, 2, 0]^T$ to $[2, 2, 4]^T$. Show that their vectors are orthogonal.

Q 5: There are two parallel vectors, each of length 3.5. Determine the magnitudes of both, their dot product and cross product.

Q 6: There are two orthogonal vectors, each of length 3.5. Determine the magnitudes of both, their dot product and cross product.

Q 7: Suppose that two vectors, **u** and **v**, are emitted from the origin $[0, 0, 0]^T$ to the points $[2, -4, 0]^T$ and $[5, -3, 0]^T$ respectively. Using the dot product, determine the length of the projection of **u** onto **v**.

Q 8: Using the parametric equation of a line, determine the intersection point between the two line segments **a** ($\mathbf{p}_1 = [1, 1]^T \rightarrow \mathbf{p}_2 = [3, 3]^T$) and **b** ($\mathbf{p}_3 = [1, 3]^T \rightarrow \mathbf{p}_4 = [3, 1]^T$).

Q 9: Consider the tetrahedron whose vertices are $\mathbf{a} = [1, 1, 1]^T$, $\mathbf{b} = [0, 1, 1]^T$, $\mathbf{c} = [0, 0, 1]^T$, and $\mathbf{d} = [0, 0, 0]^T$. What are the normals of the four triangles that bound the tetrahedron? Use the right-hand rule. Hint: To calculate the cross product of two vectors, $\mathbf{u} = [x_0, y_0, z_0]^T$ and $\mathbf{v} = [x_1, y_1, z_1]^T$, use the following operation: $\mathbf{u} \times \mathbf{v} = [\mathbf{u}]_\times \mathbf{v} =$

$$\begin{bmatrix} 0 & -z_0 & y_0 \\ z_0 & 0 & -x_0 \\ -y_0 & x_0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ y_1 \\ z_1 \end{bmatrix}$$

Q 10: Determine the point of intersection between a line and a plane. The line segment is given by its two endpoints $\mathbf{p}_0 = [3.0, 4.0, 5.0]^T$ and $\mathbf{p}_1 = [5.0, -1.5, 4.0]^T$. The plane equation is given by the vector $[6.0, -2.0, 1.5, -4.0]^T$ or $6.0x - 2.0y + 1.5z - 4.0 = 0.0$.