CGRA 151 Introduction to Computer Graphics
Mathematics Worksheet

Give answers to the following twenty mathematics questions. You may handwrite or typeset your answers but you must submit your answers as a PDF le via the ECS submission system.

You are given the following vectors and matrices:

$$\mathbf{a} = \begin{bmatrix} 1 \\ 4 \\ 8 \end{bmatrix} \quad \mathbf{b} = \begin{bmatrix} 8 \\ -4 \\ 1 \end{bmatrix} \quad \mathbf{c} = \begin{bmatrix} 2 \\ -2 \\ 1 \end{bmatrix} \quad \mathbf{d} = \begin{bmatrix} 8 \\ 0 \\ 6 \end{bmatrix}$$

$$\mathbf{A} = \begin{bmatrix} 0 & 5 & 0 \\ -5 & 3 & 0 \\ -1 & 0 & 2 \end{bmatrix} \quad \mathbf{B} = \begin{bmatrix} 3 & 5 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad \mathbf{C} = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix}$$

1. $\mathbf{a} + \mathbf{b}$
2. $\mathbf{c} + \mathbf{d}$
3. $3\mathbf{a}$
4. $-2\mathbf{b}$
5. $\mathbf{a} - \mathbf{b}$
6. $|\mathbf{a}|$
7. $|\mathbf{b}|$
8. $\mathbf{a} \bullet \mathbf{b}$
9. $\mathbf{c} \bullet \mathbf{d}$
10. What is the angle between vectors $\mathbf{a}$ and $\mathbf{b}$?
11. What is the angle between vectors $\mathbf{c}$ and $\mathbf{d}$?
12. How long is the projection of vector $\mathbf{c}$ onto vector $\mathbf{d}$?
13. Calculate $\mathbf{e}$, the linear interpolation between $\mathbf{c}$ and $\mathbf{d}$, $\mathbf{e} = (1 - t)\mathbf{c} + t\mathbf{d}$, for $t = 0.8$.
14. $\mathbf{Ab}$
15. $\mathbf{Bc}$
16. $\mathbf{A} + \mathbf{B}$
17. $\mathbf{AB}$
18. $\mathbf{BC}$
19. What two-dimensional transformation is represented by the 3×3 matrix $\mathbf{C}$?
20. Give a 3×3 matrix that represents a rotation in two-dimensional space of $60°$.