

Computer Graphics Fall 2020
Assignment – E1
Due on, November 1, 2020

This assignment has double weight. It will serve as good review for a related quiz. You may want to consult with the WDS (Shoaff) notes for this material.

Submission Instructions:

1. Please submit your work directly in TRACS (using the TRACS editor) or as a text/MS-word/PDF attachment by the due date/time. Please use only zip for compression.
2. It must be your own work – a penalty of at least one grade in your final grade and a report to the Dean of Students will result from sharing work or using other people work.
3. Please submit your assignment by the deadline – late submission will not be accepted and will result in a grade of 0. A grade of 1 denotes an issue with your assignments, which you have to resolve with the instructor.
4. **Please do not submit your assignment via email. If you have a justified documented reason for being late then please submit the assignment to your TRACS drop-box and notify me by email.**
5. Please write your name in the assignment header and as a part of the file name of the attachment.
6. It is OK to hand-write your solutions using a “pen/pencil” and papers and then scan the papers.

Assignment Instructions:

The goal of this assignment is to review the basic mathematical concepts presented in chapter 3 of the book. You can consult with the PDF file “math.pdf” available on TRACS.

1. Transform the points $P = (2,3,4)$, $Q = (-4,5,2)$, $R = (2,3,1,3)$, and $S = (-4,5,2,a)$ into normalized homogeneous coordinates.
2. Draw the vectors: $u = (-2,3)$; $v = (5,-4)$; $u + v$; and $P - Q$.
3. What is the dot product of u and v .
4. What is the cross product of these two vectors
5. What is the length of each of the above vectors?
6. What is the parametric form of the line segment from R to S ?
7. What is the parametric form of the plane containing points P, Q, R
8. What is the parametric form of the triangle with vertices Q, R, S
9. What is the inner product of two vectors (x_0, y_0) and (x_1, y_1) ?
10. What is the cosine of the angle between the above vectors?
11. What is the angle between the above vectors?
12. Find a vector orthogonal to the vector $(2,3,1)$.
13. Given the plane $3x - 4y + 7z - 3 = 0$, what is its surface normal?

Consider a trapezoid R , a square S , and a triangle T

$$R = \{(-1, 0), (1, 0), (2, 1), (-2, 1)\}$$

$$S = \{(0, 0), (1, 0), (1, 1), (0, 1)\}$$

$$T = \{(-1, 0), (1, 0), (0, 1)\}$$

14. Translate T by 3 in x and 5 in y

15. Scale R by 2 in x and 4 in y

16. Rotate S by 30° about the Z axis

17. Reflect R about the line $x = 1$

18. Scale T by 2 in x and 4 in y with fixed point $(1,1)$

19. Rotate S by 45° with fixed point $(1,1)$ about the y axis

20. Rotate T by 60° around the vector $(1,1,1)$

a. Undergraduate students only – show the OGL instruction

b. Graduate student only – show the actual mathematical operations

21. What is the inverse of the matrix

1	0	0
0	1	0
-1	2	1

22. What is the inverse of the matrix

5	0	1
0	.5	1
0	0	1

23. What is the inverse of the matrix

.5	$\frac{-\sqrt{3}}{2}$	0
$\frac{\sqrt{3}}{2}$.5	0
0	0	1

24. Show that translations and scales do not commute

25. Suppose you want to scale an object about the fixed point $(3, 2, 5)$ by scale factors 5, 7, 9 in x, y , and z respectively. What 4×4 matrix would perform this transformation?