CSE 287: Practical Learning Objectives

The following is a list of practical instructional objectives for CSE 287. Each describes some action or task that students should be able to perform. Several include the conditions under which the action or task should be performed.

Chapter One (Introduction)

1. Describe or identify differences, strengths, and weaknesses of image-order and object-order rendering algorithms.

Chapter Two (Mathematics)

2. Use the quadratic equation to find the roots (solutions) or a second order polynomial.
3. Given the value of the "discriminant" in the quadratic equation, state the number of real solutions to the equation.
4. Write code or "by hand" convert radian measures of angles to degrees and degrees to radians.
5. Given the cosine of an angle, use the arccosine to the find the angle.
6. Describe or identify the differences between scalar and vector quantities.
7. Use vector addition and subtraction to solve problems in computational geometry.
8. Use scalar multiplication to change the length of a vector and/or reverse its direction.
9. Given a vector, calculate its length/magnitude.
10. Given two points, calculate the distance between the points.
11. Given a vector, normalize it to unit length.
12. Given a vector, find a new vector that points in the same direction and has a specified length.
13. Given two points, calculate a unit length vector that points from one point to the other.
14. Given two vectors, calculate the dot product of the vectors.
15. Write an expression the represents the geometric interpretation of the dot product. State how this changes when the two vectors are unit length.
16. Use the dot product and the arccosine function to find the angle between two vectors.
17. Given the value of a dot product, state whether the vectors are parallel, perpendicular, less than ninety degrees, or more than ninety degrees apart.
18. Given two vectors, use the dot product to find the parallel and/or perpendicular components of one to the other.
19. Describe how the cross product is geometrically related to the multiplicands in the product.
20. Given two vectors, use the right-hand rule to correctly order the vectors so that their cross product points in a specified direction.
21. Given three points that describe the corners of a parallelogram, use vector subtraction and the cross product to find the area of the parallelogram.
22. Given three points that describe the corners of a triangle, use vector subtraction and the cross product to find the area of the triangle.
23. Given the equation that implicitly describes a surface and the coordinates of a point, calculate a signed distance from the surface to the point.
24. Given three points on a plane, use them to calculate a unit length vector that is normal to the plane
25. Given three points on a plane, use them to create an implicit description of the plane.
26. Given two points on a line, use them to generate a parametric representation a line.
27. Given two points on a line, use them to generate a parametric representation a line in which the direction vector is unit length.
28. Given a parametric description of a line and value of the parameter, t, find the coordinates of that point on the line that is associated with the value of the parameter.
29. Given a parametric description of a line and the coordinates of a point, determine whether or not the point is on the line.

30. Given a parametric description of a line and the coordinates of a point on the line, find the value of the parameter, t, for that point.

Chapter Three (Raster Displays)

31. State what "pixel" is short for.
32. Give or identify a definition for "color depth."
33. State the values for alpha that are normally associated with totally transparent surfaces and totally opaque surfaces.
34. Given the red, green, blue, and alpha components of two colors, use alpha blending to blend together the two colors.

Memorize

Memorize how to perform the basic vector operations for addition, subtraction, and scalar multiplication.

Memorize the following:

Mapping from one interval to another:

$$x' = (x - fromLow)\frac{toHigh - toLow}{fromHigh - fromLow} + toLow$$

Parametric Representation of a Line:

$$\mathbf{p}(t) = \mathbf{p_0} + t(\mathbf{p_1} - \mathbf{p_0})$$

$$\mathbf{p}(t) = \mathbf{p_0} + t\frac{(\mathbf{p_1} - \mathbf{p_0})}{\|(\mathbf{p_1} - \mathbf{p_0})\|}$$

Length of vector:

$$\|\mathbf{a}\| = \sqrt{x_x^2 + y_x^2 + z_x^2}$$

Vector Normalization:

$$\hat{\mathbf{a}} = \frac{1}{\|\mathbf{a}\|}\mathbf{a} = \frac{\mathbf{a}}{\|\mathbf{a}\|}$$

Dot Product:

$$\mathbf{a} \bullet \mathbf{b} = x_a x_b + y_a y_b + z_a z_b$$

$$\mathbf{a} \bullet \mathbf{b} = \|\mathbf{a}\|\|\mathbf{b}\|\cos\alpha$$

Parallel and Perpendicular components

$$\text{proj}_\mathbf{b}\mathbf{a} = \frac{\mathbf{a} \cdot \mathbf{b}}{\|\mathbf{b}\|^2}\mathbf{b}$$

$$\text{perp}_\mathbf{b}\mathbf{a} = \mathbf{a} - \text{proj}_\mathbf{b}\mathbf{a} = \mathbf{a} - \frac{\mathbf{a} \cdot \mathbf{b}}{\|\mathbf{b}\|^2}\mathbf{b}$$

Implicit Equation of a Plane:

$$(\mathbf{p} - \mathbf{a}) \bullet \mathbf{n} = 0$$

Implicit Equation of a Sphere:

$$\|\mathbf{p} - \mathbf{c}\|^2 - r^2$$