Computer Science 591B, Graphics

http://www.cs.umass.edu/∼elm/graphics/

Test 2: Review Sheet

You should know the following material:

1. Everything from the test 1 review sheet (see below for a copy of the test 1 review).
2. Understand how to use barycentric coordinates to interpolate *any* value across a triangle. If I give you values at each vertex of a triangle, you should be able to calculate the linearly interpolated values at each point inside the triangle using barycentric coordinates.
3. Know how to find the normal vector to the surface of a sphere at a particular point on the sphere.
4. Know how to find the normal to a triangle, given its vertices. The normal can point in either direction.
5. Know how, given the coordinates of a point in a 3-D (u,v,w) coordinate system, how to compute the coordinates of the same point in an (x,y,z) coordinate system. You can assume you are given the origin, and the the u, v, and w vectors in the (x,y,z) coordinate system. You can also assume you have a function which gives you the inverse of an arbitrary matrix.
6. Know how to compute the direction (as a unit vector) of a reflected ray from a surface, given the direction of the incoming ray, and the normal to the surface it is hitting. You may assume the surface being hit is flat, and that the surface is a perfect mirror.
7. Know the difference between 3D texture mapping and 2D texture mapping, and how to do each one of them. Know how to show a repeated texture, which is discussed in the book.
8. Know what Phong shading is and what Gouraud shading is. You should understand what two-sided lighting is, one-sided lighting, and the fact that the surface normal and lighting direction should be unit vectors for the formulas I gave in class to work correctly. You should understand why the normal vector should point away from a surface in order to get one-sided lighting to work properly. You should know what the Phong exponent is and what general effect it has on specularities.
9. You should understand the terms *specular, reflective, matte, Lambertian, and diffuse*.
10. You should know how to do a cross product of two 3-dimensional vectors.
11. You should know how to normalize a vector, i.e. make it into a vector in the same direction but with unit length.
12. You should be able to derive the equations for computing the intersection of a ray with the plane containing a given triangle. You do not need to be able to solve the whole thing by hand, as this requires the inversion of a 3x3 matrix, but you should be able to express the result as the inverse of a matrix that you can write down, multiplied by a vector that you can specify exactly.

Here is the previous review sheet in case you didn't have it.

1. Basic structure of the frame buffer and the representation of a pixel as a concatenation of four bytes, where the last three bytes represent the strength of the red, green, and blue components of the pixel.
2. Basic line-drawing algorithms, as in Assignment 1.
3. Properties of the following transformations: rigid, similarity, linear, affine, and perspective. Know what properties of the image each of these types of transformations preserves, such as angle, straightness, parallelness, etc.

4. Know how to implement linear tranformations in two dimensions with two by two matrices, including shearing, scaling (separate scaling in each direction), rotation, and reflection.

5. Know how to implement translation (shifting) in two dimensions by adding a simple offset vector to the coordinates of a point.

6. Know how to implement affine transformations in two dimensions with three by three homogeneous matrices applied to a "homogenized" vector, i.e. a vector where a "1" has been added to the end of the vector. In addition to the linear transformation, you should be able to implement translation with these matrices.

7. Understand why we use "forward" transformations when transforming geometric objects like squares and triangles, but we use "backward" transformations when transforming bitmaps.

8. Know how to find the inverse of the product of matrices.

9. Know how to find the inverse of each kind of basic transformation matrix, including all of the basic affine transformations: shearing, scaling, rotation, translation, and reflection.

10. Know the strategy of moving a point within an object to the origin (using a translation matrix) before applying another sort of transformation, so that the transformation does not "move" the object.

11. Make sure you have read chapter 21 in the book.

12. In two-dimensions, know how to find the area of a triangle given its three vertices.

13. In three dimensions, know how to compute the cross product between two vectors. This results in a vector perpendicular to the original two whose magnitude is equal to the sine of the angle between the vectors times the product of the magnitude of the two vectors.

14. Know how to find the magnitude of a vector in two or three dimensions.

15. Know how to derive the barycentric coordinates for a point in a triangle.

16. Have a basic idea of what a pinhole camera is and how it works. Know that a pinhole camera obeys the image formation model of "perspective projection".

17. Suppose we have a canonical coordinate system defined by an origin **o** and perpendicular, unit vector axes **x** and **y**. Now you are given, in these x-y coordinates, the origin **e** and the **u** and **v** axes of another perpendicular coordinate system. Be able to find the coordinates of a point p in u-v coordinates given its coordinates in x-y. Similarly, be able to find the coordinates of a point p in x-y coordinates given its coordinates in the u-v system.