

CS5500 Computer Graphics  
Graphics Pipeline (Parts 2 of 3)

**Assigned: May 8, 2006**

**Due: 23:59 May 21, 2006 (10% penalty for each day late)**

Extend your graphics pipeline to handle:

- (1) Triangles in 3D world space
- (2) Lighting using the Phong illumination model
- (3) Rasterization and Gouraud shading
- (4) Hidden surface removal using the Z buffer

The input file to your program is now extended to:

```
eye: xEye, yEye, zEye
lookat: xLook, yLook, zLook
up: xUp, yUp, zUp
Perspective: vFOV, near, far
display: width, height

light_pos: x, y, z, w
light_color: r, g, b

translate: x, y, z          <--- Optional
rotate: angle, xAxis, yAxis, zAxis <--- Optional
color: r, g, b
material: Ka, Kd, Ks, shininess
triangle:
    normal: nx1, ny1, nz1
    vertex: x1, y1, z1
    normal: nx2, ny2, nz2
    vertex: x2, y2, z2
    normal: nx3, ny3, nz3
    vertex: x3, y3, z3
triangle:
    ...
```

## TASKS

- (a) When you transform a vertex from 3D world space to 2D screen space, remember to compute its  $Z$  as well. The  $Z$  values will be used for hidden surface removal.
- (b) In the above example, the same color is set to all 3 vertices of the triangle. However, it is possible to set a different color to each vertex by adding a "color: r, g, b" line before each vertex.
- (c) Apply Phong illumination model to shade each triangle vertex. Store the shaded color with the vertex for the next step (rasterization).
- (d) Once you have computed the screen coordinates for all 3 vertices of the triangle, you may now fill its interior by scan line conversion. Note that it is not required to use Bresenham's algorithm to do the edge walking (for setting up the span for each scan line).

## CS5500 Computer Graphics Graphics Pipeline (Part 3 of 3)

**Assigned: May 8, 2006**

**Due: 23:59 May 28, 2006 (10% penalty for each day late)**

Extend your graphics pipeline to handle perspective correct texture mapping.

The input file to your program is now extended to:

```
eye: xEye, yEye, zEye
lookat: xLook, yLook, zLook
up: xUp, yUp, zUp
Perspective: vFOV, near, far
display: width, height

light_pos: x, y, z, w
light_color: r, g, b

translate: x, y, z          <--- Optional
rotate: angle, xAxis, yAxis, zAxis <--- Optional
color: r, g, b
material: Ka, Kd, Ks, shininess
texture2d: filename.ppm
triangle:
    normal: nx1, ny1, nz1
    texcoord: u, v
    vertex: x1, y1, z1
    normal: nx2, ny2, nz2
    texcoord: u, v
    vertex: x2, y2, z2
    normal: nx3, ny3, nz3
    texcoord: u, v
    vertex: x3, y3, z3
triangle:
    ...
```

### TASKS

- (e) The texture image is stored in the PPM format. See the example code in the data folder to read and write image files in the PPM format.
- (f) Mip-mapping is not required in this project.
- (g) You may use either the nearest neighbor or the bilinear interpolation for texture filtering.