Dept: _____

Name: _____

ID: _____

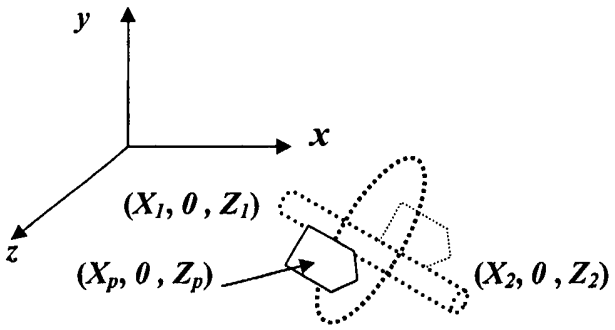
Computer Graphics — Midterm

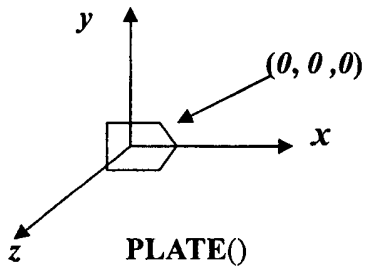
The total score is 100 points

Nov. 2005

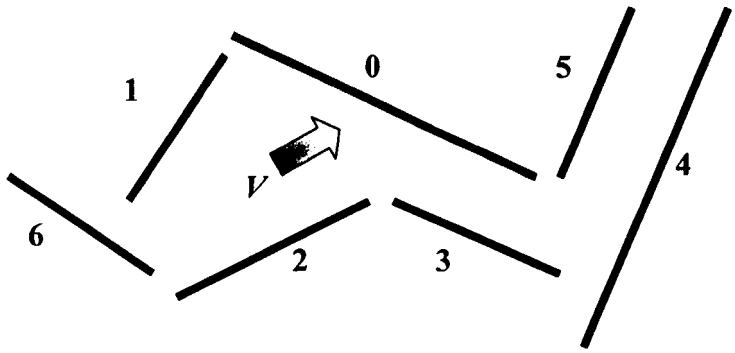
1. Please introduce the following terms.
   (a) What's "texture mapping"? Why is it useful? (10%)
   (b) What's "shadow map"? (10%)

2. In a 3D animation film, we would like to make a plate rotate around a invisible wand in a constant angular velocity θ (per frame). The two ends of the wand are $(X_1, 0, Z_1)$ and $(X_2, 0, Z_2)$ and the starting position of the plate is $(X_p, 0, Z_p)$. Please write OpenGL-like pseudo-codes and comments to show the animation. In addition to basic flow control functions, **PLATE**(), you can also use Identity matrix function: $I()$, rotation functions: $R_x()$, $R_y()$, $R_z()$, translation function: $T(x,y,z)$, trigonometric functions, e.g. sin(), asin() ,etc. (15%)





3. In the graphics pipeline, we have several steps: "perspective division", "clipping", "projection (normalized view volume)", "hidden surface removal", "scan conversion", etc.
   (a) Please put these 5 steps in proper order and give a brief introduction to each term. (15%)
   (b) In the step "hidden surface removal", "Z-buffer" is a widely-used approach. Please explain how it works. (10%)
   (c) Binary Space Partitioning (BSP) Tree is an object-space approach for hidden surface removal. Please draw the BSP tree of the following scene and show the back-to-front rendering order of the polygon set for the view point V. {We assume that the direction toward the left-hand side is the frontal face and the left sub-tree of a node is for its frontal space partition.}(15%)



4. In real-time computer graphics, we use simplified models to efficiently render a virtual environment. For instance, we use polygons to approximate surfaces, interpolated shading for reflection or texture mapping.
   (a) Please compare the Gouraud shading with the Phong shading method. (10%)
   (b) These approximations (using polygonal models and interpolation) may cause visual flaws. Please exemplify three problems and discuss how to reduce or avoid these problems. (15%)