

CS 4204 – Computer Graphics

Exam 2 Review Spring 2008

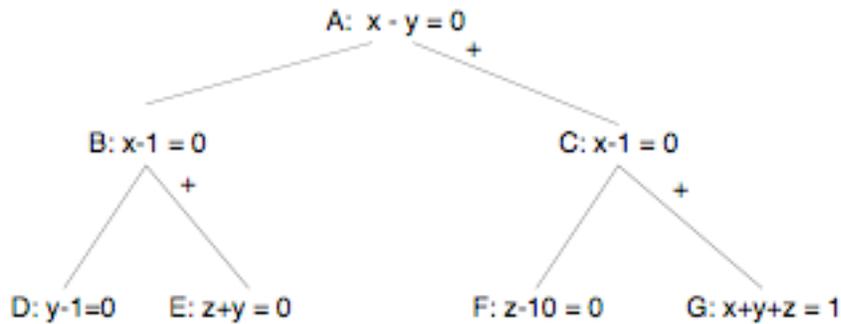
The exam will cover material discussed in class and in the readings since the first exam. Topics will include 3D viewing, lighting and shading, hidden surface removal, texture mapping, ray tracing, polygonal modeling, and modeling with curves and surfaces.

Example short answer questions:

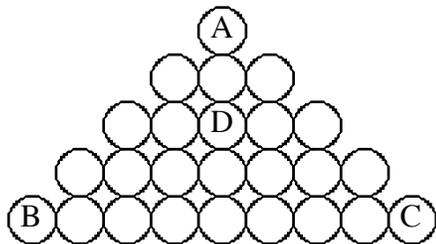
1. In the z-buffer algorithm, is the order of rendering for polygons important? Why or why not?
2. Define linear interpolation. In the z-buffer algorithm, is linear interpolation an exact reflection of reality or an approximation? Why?
3. Define back-face culling. Why is this not a general-purpose solution to the hidden surface problem?
4. What is ambient illumination? What does it approximate from physical reality?
5. Which term in the Phong illumination model does NOT use the material (color) properties of the object being illuminated? Why?
6. Why is texture mapping so important for real-time rendering?
7. Describe the process of determining a pixel's color when rendering a polygon with a texture map.
8. Define the following terms from ray-tracing: primary ray, shadow ray, reflection ray.
9. Describe the algorithm used to determine whether a ray intersects a polygon.
10. Why are parametric equations often used to represent curves?
11. How are Bézier and Hermite curves related? What property do Bézier curves have due to the use of the constant 3 in this relationship?
12. Describe a basic algorithm for rendering parametric cubic curves.
13. Explain the concept of a blending function. How does one obtain the blending functions for a family of curves?
14. Why is the $Q(t) = TMG$ form used instead of the more compact $Q(t) = TC$ form for parametric curves?
15. Why is it possible to build a 3D polygonal model without using the process of 3D polygonal modeling?
16. Describe one method to manage the speed-realism tradeoff using level of detail (LOD).

Example problems:

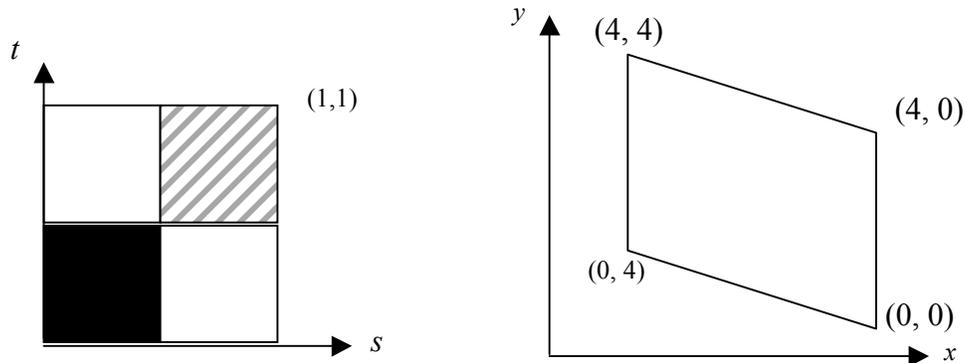
- Given a View Plane Normal, $VPN = [4, 0, -7]$ and a View Up Vector, $V_{up} = [2, 0, 0]$, calculate the u , v , and n vectors that define the x , y , and z axes of the Viewing Reference Coordinate System relative to the World Reference Coordinate System.
- Given the BSP-tree shown below and an eyepoint at $(0, 10, -5)$, in what order would the polygons A, B, C, D, E, F, G be rendered? Note that the equation for the plane that each polygon lies in is given and that the front side of each node is marked with a +.



- Two triangles, A and B, have been projected onto a window centered at the origin that is 3 units wide and 2 units high. The projected vertices for A are: $(0,0)$, $(1.4, 1.4)$, and $(1.4, 0)$. The projected vertices for B are: $(0.2, 0.9)$, $(0.2, -0.9)$, and $(-2, 0)$.
 - Find the locations of these vertices after mapping them to a viewport whose origin is at the lower-left corner, and which is 60 pixels wide by 60 pixels high.
 - What are the new screen coordinate vertices for triangle B after clipping?
 - The 2 triangles overlap at pixel $(30,30)$. Given depth values for triangle A of -1 , -1 , and -1 for each of its vertices, respectively, and depth for triangle B of -1.5 , 0 , and -0.5 for each of its vertices, respectively, which triangle's color should be drawn for pixel $(30,30)$?
- Assume a Gouraud shading model for the triangle below. Pixel A has been assigned the color $(100,100,100)$, pixel B is color $(80, 50, 50)$ and pixel C is $(70, 90, 70)$. What color should be assigned to pixel D?



5. Sketch the result of texture mapping the image shown on the left to the quadrilateral shown on the right, with texture coordinates as shown next to the quadrilateral's vertices. Assume that texture coordinates wrap if they exceed 1.



6. You want to join two Bézier curves. The first curve must start at $(0,0,0)$ with a tangent vector of $(1,1,1)$. The second curve must end at $(5,0,-5)$ with a tangent vector of $(-1,-1,-1)$. The two curves should be joined at $(2,5,0)$ and have C^1 continuity. Give the geometry matrices for each curve.
7. Find the parametric equations of the Hermite curve with $P1=(-1,0,-1)$, $P4=(1,0,1)$, $R1=[0,-1,0]$, $R4=[0,1,0]$. What is the velocity along this curve at $t=0$, $t=0.5$, and $t=1$?
8. Given an eyepoint at $(0,0,0)$, a pixel at $(-3, 2, -4)$, and a sphere of radius 5 with its center at $(-5, 10, -10)$, does the ray from the eyepoint through the pixel intersect the sphere? If so, what is the intersection point?
9. Given a ray beginning at the point $R_0=(4,0,0)$ with direction $R_d=[1,1,0]$, and a polygon with vertices $(5,2,2)$, $(5,3,-2)$, and $(5,-1,0)$, does the ray intersect the polygon? If so, what is the intersection point?