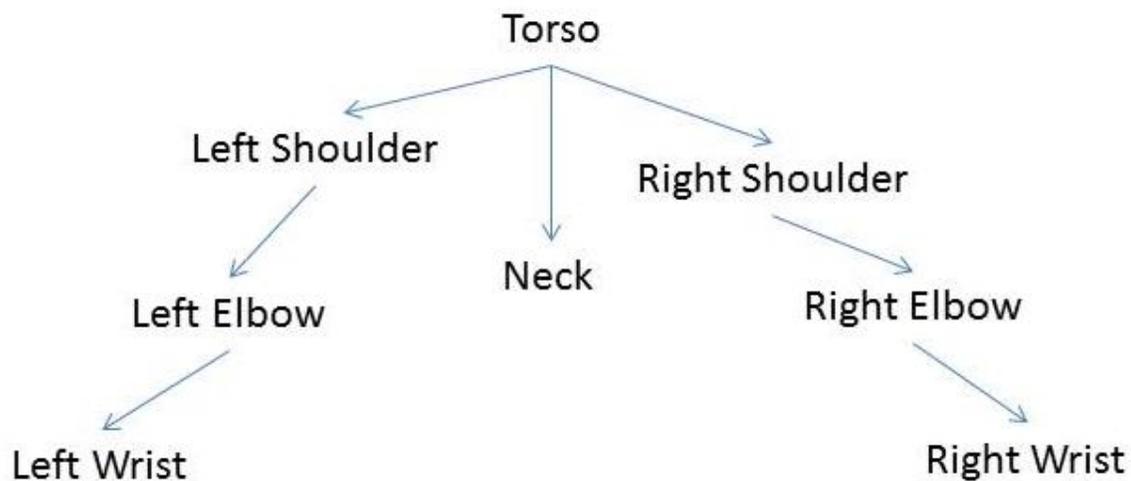


CS 112: Introduction to Computer Graphics (Winter 2016)
Written Assignment 3 (Total Points = 95)
Due: Wednesday, 9 March

- 1) **[5+5=10]** You are rendering a black and white checkered tiled floor using a single texture mapped polygon. The view is simulating a person standing on the floor and looking at a point far away from him on the floor. (1) Artifacts at the distant end of the floor can be seen. How would you remove these artifacts? (2) How can you explain why this method works using sampling theorem?
- 2) **[5]** One artifact of Gouraud shading is that it can miss specular highlights in the interior of the triangles. How can it be explained as an aliasing artifact?
- 3) **[3 + 4=7]** You are given a display which has spatial resolution of 1000x1000 and a gray intensity resolution of 8. You would like to increase your intensity resolution to 50. How would you achieve this by giving up some of the spatial resolution? What is the minimum factor (i.e. no. of pixels for each unit) by which you have to trade off the spatial resolution to do so?
- 4) **[3 + 3 + 9 = 15]** Consider two balls A and B with radius 2 and 4 respectively. Their centers are given by (4,4) and (5, 12) respectively.
 - a) What are the four coordinates of the axis aligned bounding boxes of A and B?
 - b) Do A and B collide? Justify your answer.
 - c) B undergoes a translation of (1,-6). What is the new bounding box of B? Do the bounding geometries of A and B collide now? Justify your answer.



- 5) **[5 + 3= 8]** Consider the above hierarchical object representation.
 - a) What will be the order of rendering of the different parts of the tree?
 - b) Which OpenGL feature and calls will you use to achieve this rendering?

- 6) **[5]** You have captured an image using your camera and it looks great when seen on the panel of the camera. Then you import it to your laptop and it looks kind of underexposed and darkened when viewed on the laptop. You suspect something is wrong with your display gamma function. What is the most likely problem and how would you fix it?
- 7) **[2 + 3 = 5]** Consider five objects in the line of sight from the eye. Object i is behind Object $i-1$. Object 1, 3 and 5 are opaque while the others are translucent. In what order would you render the objects to get the correct effect of translucency? Justify your answer.
- 8) **[10+10=20]** Consider a raytracing application. Eye is at $(0,0,0)$ and the view direction is Z-axis. The framebuffer is defined by the four sides $l = -200$, $r = 200$, $b = -100$, $t = 100$ and at a distance of $Z=50$. We are trying to render the pixel at $(50, 50)$. Where would the ray for this pixel intersect two elements in the scene: (a) a plane given by $x+y+z = 200\sqrt{3}$; and (b) a sphere with center at $(150,150)$ and radius of 100.
- 9) **[4+4+4=12]** Consider a quadratic (degree 2) curve $Q(t)$. This is given by the multiplication of the coefficient matrix C and the polynomial matrix T , i.e. $Q(t) = CT$.
- (a) What would be the matrix T for this curve?
- (b) How many points would you need in the geometry matrix to find the coefficient matrix for this curve?
- (c) What would be the blending functions for this curve if the inverse of the basis matrix is given by

$$\begin{bmatrix} 1 & -2 & 1 \\ -1 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$$

- 10) **[4+4=8]** Consider two hermite curves $H1$ and $H2$ sharing a common point $P2$. Thus, the control points of $H1$ is given by $[P1 P2 T1 T2]$ and that of $H2$ is given by $[P2 P3 T3 T4]$. $T1$ and $T2$ define the tangents for $H1$ at $P1$ and $P2$ respectively. Similarly, $T3$ and $T4$ are the tangents for $H2$ at $P2$ and $P3$ respectively.
- (a) What kind of continuity do you have at $P2$?
- (b) What kind of constraints would you put on the control parameters to have G^1 continuity at $P2$?