

**CS 112: Introduction to Computer Graphics (Winter 2020)**  
**Written Assignment 2 - Solution**

**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?

**(1) We can remove artifacts using Mipmapping.**

**(2) Because the distant end of the floor is small and we don't have enough pixels to choose enough samples.**

**2) [5]** One artifact of Gouraud shading is that it can miss specular highlights in the interior of the triangles. How can explained as an aliasing artifact?

**In Gouraud shading, we only calculate the illumination for the vertices. As a result, we don't have enough samples. However, in Phong shading we calculate the illumination for all the pixels and have more samples.**

**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 the 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 must trade off the spatial resolution to do so?

$$n^2(k-1) + 1 \geq 50 \implies 7n^2 + 1 \geq 50 \implies n = 3$$

**So, we will reduce the spatial resolution by factor of 9.**

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?

**Axes aligned bounding box of A: (6,6), (6,2), (2,2), (2,6)**

**Axes aligned bounding box of B: (9,16), (9,8), (1,8), (1,16)**

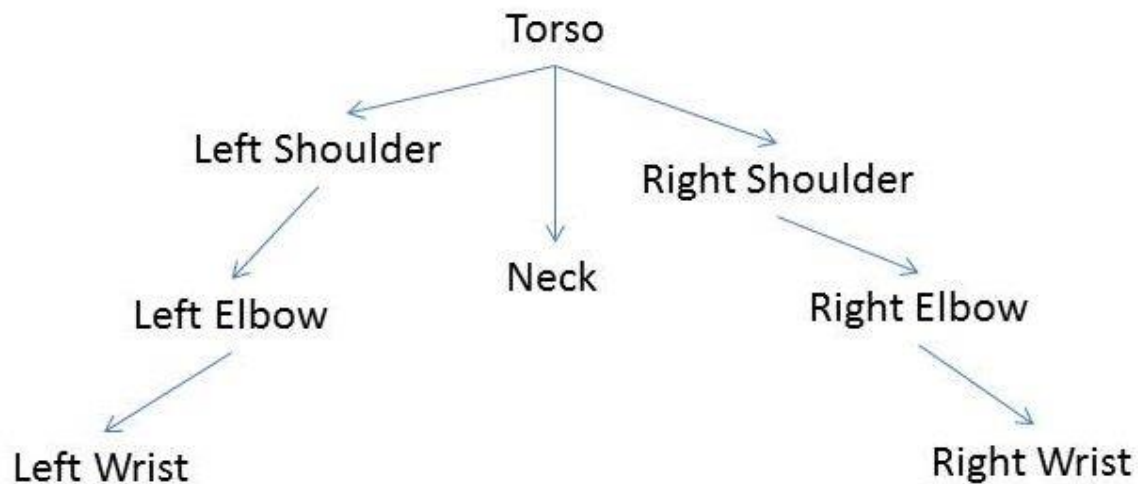
b) Do A and B collide? Justify your answer.

**No, because the distance of center of A and B is larger than sum of their radii.**

c) B undergoes a translation of (1,-6). What is the new bounding box of B? Does the bounding geometries of A and B collide now? Justify your answer.

**New bounding box of B: (10,10), (10,2), (2,2), (2,10)**

**Now A and B are colliding because the distance of their centers are smaller than the sum of their radiuses.**



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?

**Torso – Left Shoulder – Left Elbow – Left Wrist – Neck – Right Shoulder – Right Elbow – right Wrist**

b) Which OpenGL feature and calls will you use to achieve this rendering?

**Using the push and pop to add and remove the transformation in the OpenGL stack.**

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 underexposed and darkened when viewed on the laptop screen. You suspect something is wrong with your display gamma function. What is the most likely problem and how would you fix it?

**The gamma function of the display and the camera is different. So, we should find the relation between these gamma functions and change the input intensity in a way that we get same output for both.**

7) [2+3=5] Consider five objects in the line of sight from the eye. Object  $i$  is behind Object  $i-1$ . Objects 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.

**For opaque objects we should start from the one which is closer to the camera so first we render 1 and 3 and then 5. For translucent object we should start from the one which is far away from the camera. So we render 4 and after that we render 2.**