Graphics Systems and Interaction

Normal Call   2020-01-21

No. _____ Name _____

Assessment duration: 45 minutes
Value of each question: marked with brackets
Multiple choice questions: each wrong answer deducts 1/3 of the question's value

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Part I   **10%**

a. **[3.3]** A device such as a printer that recognizes the PostScript page description language will behave like a

   i.   Raster device
   ii. Vector device
   iii. Tensor device
   iv. None of the above

b. **[3.3]** Under what circumstances is a vector transformed by a translation?

   i.   Under no circumstances
   ii. Only when the direction of the translation is not perpendicular to the direction of the vector
   iii. In all circumstances
   iv. None of the above

c. **[3.3]** In OpenGL, a perspective projection associated with an asymmetric viewing volume can be achieved with functions

   i.   `glOrtho()` or `glFrustum()`
   ii. `glOrtho()` or `gluPerspective()`
   iii. `glFrustum()` or `gluPerspective()`
   iv. None of the above

d. **[3.3]** In the octree representation of 3D objects

    i.   There is ambiguity, because the same representation can correspond to several models
    ii.   The 3D space is divided into equally sized cubes
    iii. The 3D space is divided into cubes whose sides are powers of 2
    iv. None of the above

e. **[3.3]** The contribution made by the emission component of the OpenGL lighting model

    i.   Models the effect of the light reflected by other objects in the environment
    ii.   Simulates the reflection of light by highly polished objects
    iii. Simulates the fluorescence phenomenon
    iv. None of the above

f. **[3.3]** In OpenGL texture mapping, does it make sense to define the GL_NEAREST_MIPMAP_LINEAR magnification filtering method?

    i.   Yes. It will compute a weighted linear average of the 2 x 2 array of texels that lie nearest to the center of the pixel within the nearest mipmap
    ii.   Yes. It will compute the nearest texel in each of the two nearest best choice of mipmaps and then interpolates linearly between these two values
    iii. No. It will always use the highest resolution map
    iv. None of the above

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Part II   **20%**

a. **[4.0]** Suppose you want to map the texture represented in Figure 1 to a rectangle so that it looks like the one shown in Figure 2. Enter the texture coordinates (*s*, *t*) corresponding to each polygon vertex.
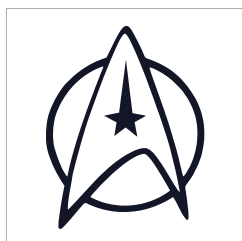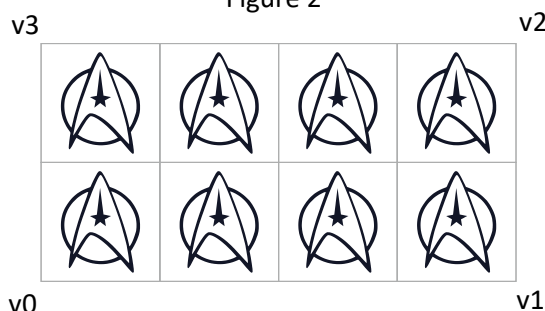
Figure 1

Figure 2

v3   v2

v0   v1

v0: _____, _____

v1: _____, _____

v2: _____, _____

v3: _____, _____

b. **[3.0]** Consider a sphere made of an orange material (1.0, 0.5, 0.0) illuminated by a single pink light source (1.0, 0.8, 1.0). What are the primary components (R, G, B) of the resulting color? Specify the calculations made.

R = _____

G = _____

B = _____

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c. **[4.0]** Compute the components of the unit vector normal to the quadrilateral shown in Figure 3. Its opposite vertices are the origin and the point (100, 100, 75). The polygon's front face is the one corresponding to the positive side of the Z axis.
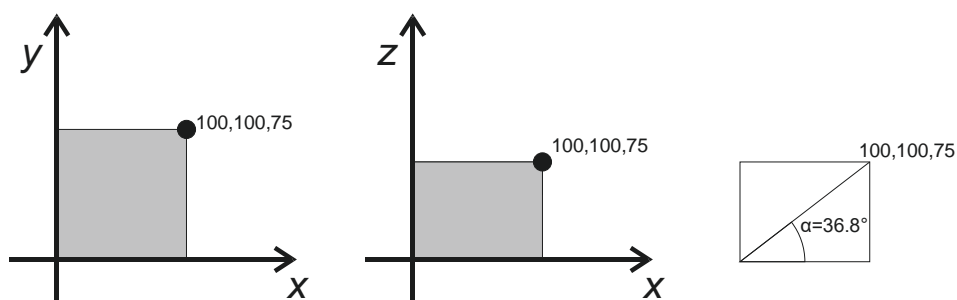

Figure 3

Normal: _____, _____, _____

d. **[4.0]** Suppose you want to simulate a camera mounted on a drone in pursuit of a car. The car's position is given by ($c.x$, $c.y$, $c.z$) and its direction by $c.dir$. The drone is programmed to always stay 5 meters above and 1 meter behind the car (Figure 4). The view must be a top view, with the front side of the car always facing the top edge of the image.
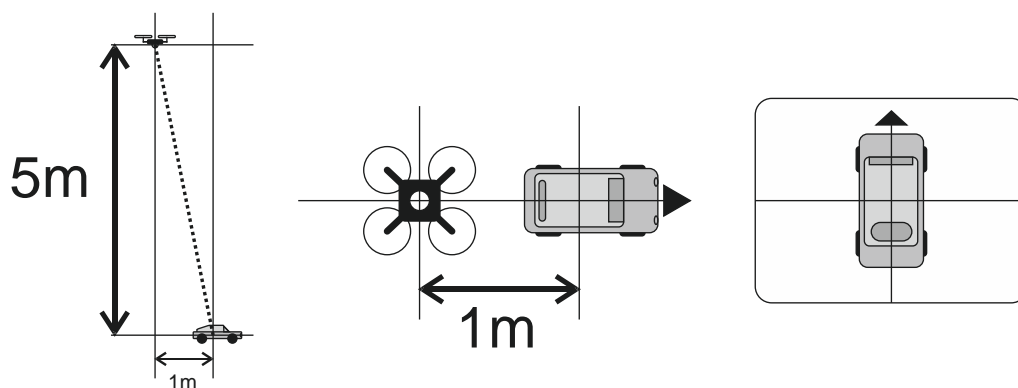

Figure 4

Complete the following information in order to obtain the desired camera, considering that the vertical direction is the Z axis direction (positive up).

Eye: _____, _____, _____

Center: _____, _____, _____

Up: _____, _____, _____

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e. **[5.0]** Consider the object illustrated in Figure 5 and the existence of the function `box()` that draws a unit cube, aligned with the axes and centered on the origin.

Further consider that:

- The origin of the coordinate system is in the center of element A;

- Element B moves vertically relative to element A;

- Element C rotates around a horizontal axis, according to the figure;

- Elements D and E move perpendicularly to object C (that is, vertically while object C has not rotated);

- **Important:** Translations of elements D and E must be made in relation to the axis of rotation of C;

- For the scene tree, use only the shapes shown in Figure 6. The circles represent transformations (and the letters S, R and T identify the type of transformation); the squares represent the calls to the `box()` function, with the letter identifying the corresponding element.
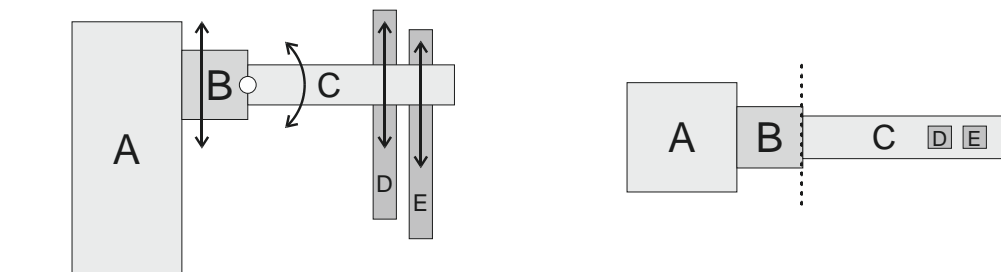

Figure 5

Figure 6

Draw the tree that represents the object on the back of this sheet.