

## Graphics Systems and Interaction

Second Call

2020-02-03

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

### Part I

10%

- a. **[3.3]** What is the size in bytes of a 1024 x 1024 x 32-bit RGBA frame buffer?
- i. 0.5 Megabyte
  - ii. 1 Megabyte
  - iii. 2 Megabyte
  - iv. None of the above
- b. **[3.3]** A perspective projection is an example of
- i. An identity transformation
  - ii. A rigid transformation
  - iii. A linear transformation
  - iv. None of the above
- c. **[3.3]** Consider the object bounded by the surface described by equation  $x^2 + y^2 - 1 = 0$ , with  $0 \leq z \leq 1$ . The point with coordinates (0.8, 0.8, 0.8) is located
- i. Inside the object
  - ii. On the object's boundary
  - iii. Outside the object
  - iv. None of the above

- d. **[3.3]** Knowledge of the normal vector is necessary to compute
  - i. Ambient and diffuse lighting components
  - ii. Diffuse and specular lighting components
  - iii. Ambient and specular lighting components
  - iv. None of the above
- e. **[3.3]** Quadratic attenuation
  - i. Does not depend on the distance between the light source and the object
  - ii. Is proportional to the distance between the light source and the object
  - iii. Is proportional to the square distance between the light source and the object
  - iv. None of the above
- f. **[3.3]** The design of WIMP interfaces (Windows, Icons, Menus, Pointer)
  - i. Should not consider the use of shortcut keys because human memory has limitations
  - ii. Should be system-centered rather than user-centered because human behavior is unpredictable
  - iii. Should draw on real-world analogies
  - 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.

Figura 1

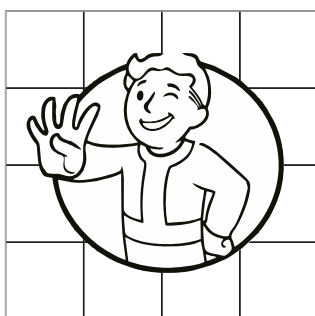


Figura 2



v0: \_\_\_\_\_, \_\_\_\_\_

v1: \_\_\_\_\_, \_\_\_\_\_

v2: \_\_\_\_\_, \_\_\_\_\_

v3: \_\_\_\_\_, \_\_\_\_\_

- b. **[3.0]** Consider a sphere made of a purple material (0.6, 0.6, 1.0) illuminated by a single orange light source (1.0, 0.5, 0.0). 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 normal (pointing outwards) of the face (marked with a black dot) of the box shown in Figure 3.

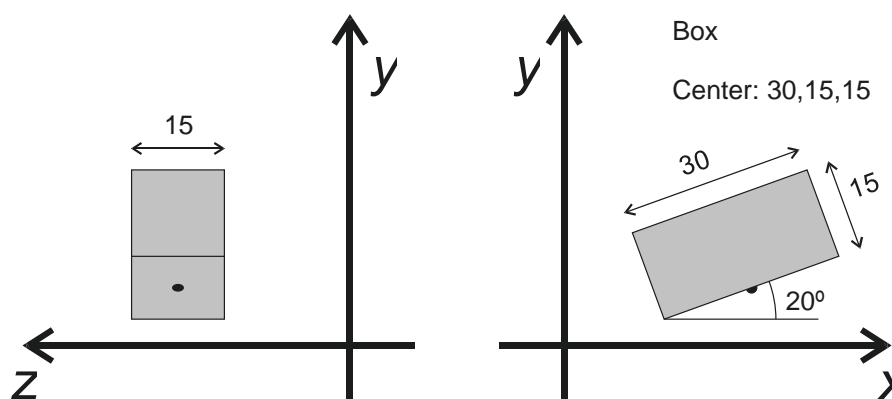


Figure 3

Normal: \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_

- d. **[4.0]** Suppose you want to simulate a camera mounted on a gutter on a room's ceiling, which can move as shown in Figure 4. The camera can rotate around the marked axis and the upward direction of the image is marked with a black dot on the lens.

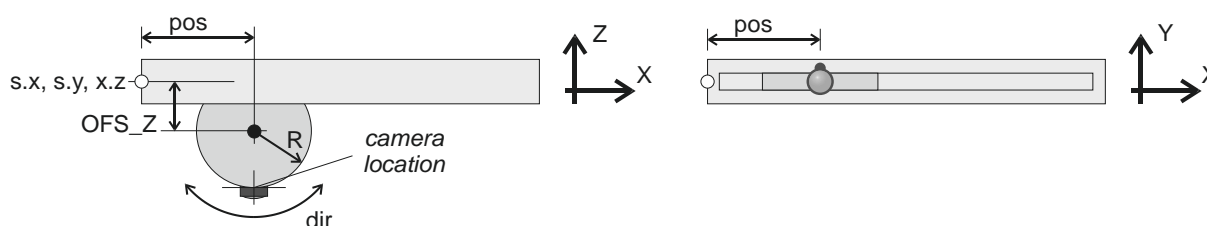


Figure 4

Complete the following information in order to obtain the desired camera.

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:

- Element A does not move;
- Elements B and C move laterally;
- Element B rotates around the axis marked with a black dot;
- Elements D and E move together and must undergo a common rotation around the axis marked with a black dot;
- 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 transformation type); the squares represent the calls to the `box()` function, with the letter identifying the corresponding element.

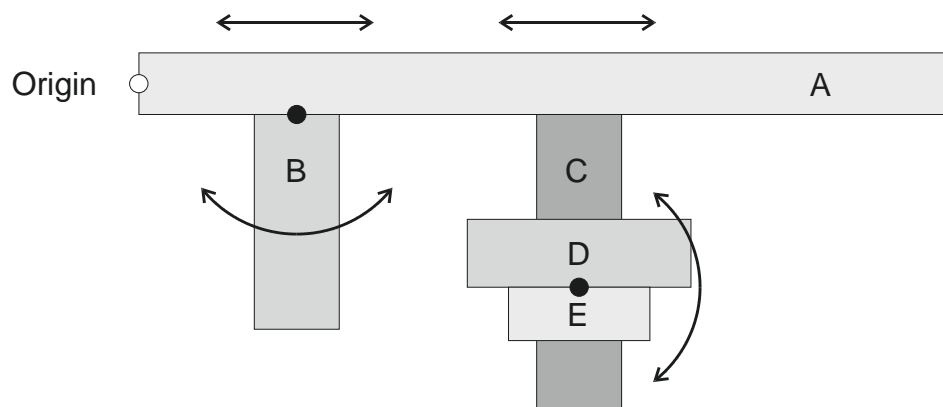


Figure 5



Figure 6

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