Question 1. Texture Mapping.

a. (1 point) Given a cylinder whose bottom plane is Y=−1 and top plane is Y=1, if \( p = \begin{bmatrix} \frac{1}{2} \\ 0.4 \\ -\sqrt{\frac{3}{2}} \end{bmatrix} \) is a point on this cylinder, what are \( p \)'s texture coordinates under cylindrical mapping (assuming that a single texture is perfectly mapped onto the cylinder)? (Note: Depending on how you define the angle, the solution is not unique. So show me the formula and how you get your solution.)

b. (1 point) Under the same mapping strategy, can you derive a cone mapping formula for a truncated cone, whose bottom radius is \( R_b \) while the top radius is \( R_t \)?
**Question 2.** Let us see how perspective distortion is fixed. Given a projection matrix $M = \begin{bmatrix} 2 & 2 \\ 1 & -1 \\ -1 & -1 \end{bmatrix}$ and two vertices $p_0 = \begin{bmatrix} 2 \\ 0 \\ 1 \end{bmatrix}$ and $p_1 = \begin{bmatrix} -2 \\ 0 \\ 5 \end{bmatrix}$. If $p_0$ has texture coordinates $(0, 0)$ and $p_1$ has texture coordinates $(1, 1)$, then the middle point $p_{01} = \begin{bmatrix} 0 \\ 0 \\ 3 \end{bmatrix}$ should have texture coordinates $(0.5, 0.5)$ by interpolation.

a. (1.5 point) Unfortunately, the graphics pipeline handles interpolation only in the projected space (clip space). After projection, $p_0$ becomes $p_0'$, $p_1$ becomes $p_1'$, and $p_{01}$ becomes $p_{01}'$. What are $p_{01}'$’s texture coordinates then by interpolation? (Note: Check homework 1 Question 3.)

b. (1.5 point) Now let us use the method provided on page 31 in the texture slides $^1$. Show how to get corrected $p_{01}'$’s texture coordinates this time.

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**Submission Guideline** Please submit your solution either electronically or in person to our grader: Xiaoyin Ge (gex AT cse.ohio-state.edu).

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