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Date: Feb 16th, 2025

1. Dichromatic Reflection Model Speed Round:
    A. True or **False**: body reflection depends on the viewer's location. (but metal's structure)
    B. **True** or False: surface reflection depends on the viewer's location.
    C. **True** or False: Surface reflection is usually highly directional and depends on the viewer's location.
    D. True or **False**: the intensity of Lambertian reflection is proportional to the dot product of the surface normal and ~~the viewing direction.~~
    E. **True** or False: metals do not exhibit body reflection.
    F. **True** or False: body reflection is caused by photons penetrating the surface and interacting with pigment particles inside the material.
    G. True or **False**: velvet looks different because of quantum interactions in the material. (surface structure)
    H. **True** or False: velvet looks different because the surface normal of the fibers are perpendicular to the overall surface normal.

2. How do you find the primary orientation of a 2-D shape (axis of least central moment)? What are the steps and what theoretical property of the pixels in the region corresponds to the orientation?

    Firstly, we can look at the axis with the least central moment. This axis matches the eigenvector of the covariance matrix that has the smallest eigenvalue. We start by calculating the second-order central moments, then build the covariance matrix, and finally solve for the eigenvectors. The orientation angle, which shows the direction where the pixels are least spread out, is given by the formula: $\theta = (1/2) * \tan^{-1}(2 \mu 11 / \mu 20 - \mu 02)$

3. What does the purpose of the grassfire transform algorithm? Describe the inputs and outputs.

    The grassfire transform algorithm helps figure out how far each pixel in a binary image is from the nearest edge.

    Input: You start with a binary image where the object pixels are marked as 1 and the background pixels as 0.

    Process: The algorithm spreads distance values from the edges inward, usually using Manhattan distance (either 4-neighbor or 8-neighbor connectivity).

Output: The result is a grayscale image where each pixel's brightness shows how far it is from the nearest background pixel, with the brightest pixels at the center of the shape.

4. When is it more efficient to grow or shrink using the grassfire transform compared to using a standard morphological filter?

   The grassfire transform is efficient because it calculates exact distances for all object pixels in one pass. This allows you to shrink or grow shapes directly from the distance map, unlike morphological operations that require multiple iterations. This makes it much faster and more efficient for multi-stage tasks.

5. What does top-down versus bottom-up mean when applied to segmentation? Give one example of each type of segmentation algorithm.

   Top-Down approaches begin with the entire image and divide it into regions using global features, like in region splitting algorithms. For example, if an image has distinct color areas, the algorithm will split the image into regions where each region has a similar color. This process continues until the regions meet a certain homogeneity criterion.

   Bottom-Up approaches start with individual pixels and combine them into regions based on local similarities, as seen in region growing algorithms. if neighboring pixels have similar intensity or color, they are grouped together to form a region. This process continues until all pixels are assigned to a region.