

# HOMWORK ASSIGNMENT 11 (THEORY)

CO19-320322: COMPUTER GRAPHICS  
320322: GRAPHICS AND VISUALIZATION

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Not graded.

## **Problem 11: Global Illumination, Texture Mapping, and Modeling** *(not graded)*

- (a) Given a triangle with vertices  $\mathbf{p}_1 = (-2, 0, 0)$ ,  $\mathbf{p}_2 = (-2, 1, 0)$ , and  $\mathbf{p}_3 = (-2, 0, 1)$ , and a sphere with radius 1 and center  $(0, 0, 0)$ . Moreover, given two point light sources at positions  $\mathbf{l}_1 = (10, 0, 0)$  and  $\mathbf{l}_2 = (0, 10, 0)$ . The viewpoint is given by  $\mathbf{v} = (0, 10, 0)$ . Apply the shadow mapping algorithm to estimate whether point  $\mathbf{p}_1$  is in the shadow with respect to the light sources.
- (b) Given a 2D texture that bilinearly interpolates between the following colors at its corners: at  $(0, 0)$  we have HSV color  $(0, 1, 1)$ , at  $(1, 0)$  we have HSV color  $(349, 0.3, 0)$ , at  $(0, 1)$  we have CMYK color  $(0.5, 0, 0.5, 0.5)$ , and at  $(1, 1)$  we have CMYK color  $(0, 0, 1, 0)$ . Given a triangle with vertices  $\mathbf{p}_1 = (0, 0, 0)$ ,  $\mathbf{p}_2 = (2, 0, 0)$ , and  $\mathbf{p}_3 = (1, 2, 0)$ , to which the respective texture coordinates  $\mathbf{s}_1 = (\frac{3}{2}, \frac{1}{4})$ ,  $\mathbf{s}_2 = (\frac{1}{2}, \frac{1}{4})$ , and  $\mathbf{s}_3 = (0, 1)$  are assigned. Plot the triangle in object space (i.e., in 3D Cartesian coordinates) and in texture space, compute the texture colors assigned to the triangle's vertices in the RGB color space, and describe the colors along its edges.
- (c) Apply a Haar wavelet transform to develop a multiresolution representation of a pixel row with intensity values  $(1, 1, 3, 3)$ . What is the possible compression rate for the given example using lossless compression? Explain your answer.