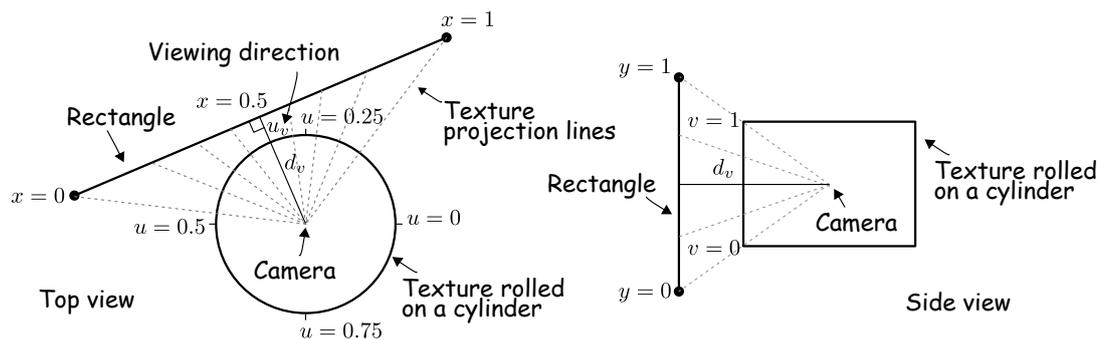


4 Introduction to Graphics (RKM)

- (a) When a 2D texture is mapped to a 3D object, the texels can be mapped to areas on the screen that are smaller or larger than the area of a single pixel. Explain what methods are used in OpenGL to ensure the best quality of rendered textures when:
- (i) Multiple texels are mapped to a single pixel. Explain what image processing operation needs to be performed and what data structure is used in OpenGL to accelerate rendering in this scenario. [5 marks]
 - (ii) There are fewer texels than pixels to be drawn. Explain two interpolation methods available in OpenGL. [5 marks]
- (b) Your task is to display a portion of a cylindrical panorama (2D image rolled on a cylinder) on a screen. To do this, you need to map a 2D texture from cylindrical coordinates to a rectangle specified by four vertices, as shown in the figure below.



- (i) Write a formula for computing u, v texture coordinates from object-space coordinates x, y . You are given the distance between the camera and the rectangle, d_v , and the viewing direction u_v in texture coordinates (from 0 to 1). For simplicity, we assume that the full height of the texture is mapped to the full height of the rectangle. Refer to the figure for further details. [6 marks]
- (ii) Justify whether texture coordinates for mapping a cylinder to a rectangle should be computed in a fragment shader or a vertex shader. [4 marks]