CS 334 Midterm Examination, Fall 2022

Student first name:

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The exam has three questions of equal weight.

Question 1. Describe a method for tessellating a disk by approximating its contour with a regular polygon with *n* sides. The method takes a single parameter, i.e., the number of sides *n*, and generates a shared vertex triangle mesh. (The size, position, and orientation can be defined using other methods in your triangle mesh class and are not the concern of the tessellation method you have to describe.)

a. Draw a figure (by hand) that shows the tessellated disk for $n = 6$.
b. How many vertices will the mesh have?
c. How many triangles will the mesh have?
d. Set the vertex array.
e. Define the triangles as triples of indices in the vertex array.
f. Use the disk tessellation method to tessellate a 2D ring, i.e., a disk with a circular hole in the middle, i.e., the difference between a bigger and a smaller disk.

Question 2. Your graphics pipeline is too slow to render a complex 3D scene at interactive rates. Specify how to accelerate the rendering of the scene leveraging each one of the three observations below. You are asked to describe one acceleration scheme for each observation.

a. Many of the scene objects, i.e., triangle meshes, do not project inside the image frame.
b. Many of the scene objects that project inside the frame are hidden by other objects.
c. Your shading, i.e., the function that computes the color at a pixel covered by a triangle, is computationally intensive, and computation is wasted when shading the same pixel for multiple triangles.

Question 3. Your graphics pipeline can render specular highlights.

a. Given a point light source *L* and a curved surface *S*, where does the specular highlight generated by *L* on *S* appear in the output image?
b. Use the specular highlight rendering approach to render a 3D triangle *T* that is reflected in *S*. Hint: think of the steps of rendering a triangle; how can one project a vertex that is first reflected? Will the edges of the reflected triangle be straight? How can they be approximated?