Exam practice questions

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1. You are given 3 3D points. Decide whether they are collinear or not.
2. Compute the intersection between a ray (O, r) and a texture mapped rectangle $A_0A_1A_2A_3$.
3. Compute the intersection between a ray (O, r) and a triangle $A_0A_1A_2$, and decide whether the intersection occurs inside the triangle or not.
4. Given a plane (O, n) and triangle $V_0V_1V_2$, clip the triangle with the plane, i.e. the result should be the part of the triangle on the positive half space defined by the plane.
5. Given two rays (O_0, r_0) and (O_1, r_1), compute the intersection between them as the midpoint of the common perpendicular.
6. You are given n 3D points. Decide whether there is a sphere such that all points are on the sphere.
7. You are given a 3D scene S, an image I of S rendered with a planar pinhole camera PPC of known horizontal field of view. Describe a procedure for finding the position and orientation of PPC used to render I. PPC has square pixels, and its eye projects in the center of the image.
8. You are given two overlapping photographs of a 3D scene. Decide whether the photographs were taken from the same location or not.
9. You are given two overlapping photographs of a 3D scene, taken from known views modeled with planar pinhole cameras PPC_0 and PPC_1. Describe a method for recovering the geometry of the 3D scene.
10. Ambient occlusion is a rendering effect where each output image pixel p is shaded according to how much of the environment is visible from p. Describe a method for rendering with ambient occlusion.
11. What are the limitations of environment mapped reflections? What are the limitations of approximating the reflection of objects close to a reflecting object using billboards? What is a better approximation of reflected objects?
12. Describe how to render soft shadows on the GPU, knowing that your scene is defined by a ground plane (i.e. a rectangle) and two boxes. The light is a rectangle.
13. You lost the geometric model of a 3D scene. All you have are renderings of the scene along a path. Describe a procedure for recovering the geometric model of the scene. First assume your renderings have color + z per frame. Then assume that they only have color.
14. You are given a cube map. You build a cube of side 1, and you texture map each face of the cube with one of the faces of the cube map. For each view, you render the environment by placing the cube at the current viewpoint. Is the result correct? In other words, when the view looks at a corner of the cube, will the image be correct, or will the image be discontinuous at the edges of the cube?
15. You are given a complex scene that you have to render with a complex shader. In other words, your scene has billions of triangles, and the fragment shader has thousands of lines. Describe a method for rendering the scene efficiently.
16. Why is a naïve ray tracer inefficient? How can ray tracing be accelerated?
17. Extend reflected billboards to support second order reflections.