

2 Advanced Graphics (PB)

- (a) Briefly explain the global illumination methods *radiosity* and *photon mapping*. Highlighting the strengths and weaknesses of each method, compare and contrast the two.

You will be marked for correctness, clarity and brevity. [8 marks]

Recall that the *signed distance field* (SDF) expression of a surface returns the signed nearest distance from a sample point to the surface. This is well-suited to ray-marching on a GPU. As an example, the SDF method describing a unit cube centred at the origin may be written in *OpenGL shading language* (GLSL) as:

```
float cube(vec3 pt) {
    return max(abs(pt.x), max(abs(pt.y), abs(pt.z))) - 1;
}
```

- (b) Give an SDF method **cyly(pt, len, radius)** for a finite cylinder of specified length and radius, centred at the origin, parallel to the *Y* axis. [4 marks]
- (c) Give an SDF method **hollowedSphere(pt)** which specifies the model shown in Figure 1: a unit sphere hollowed along each axis by a cylindrical hole of radius 0.5. [6 marks]
- (d) How would you repeat your hollowed sphere at two-unit intervals infinitely across the XZ plane as illustrated in Figure 2? [2 marks]

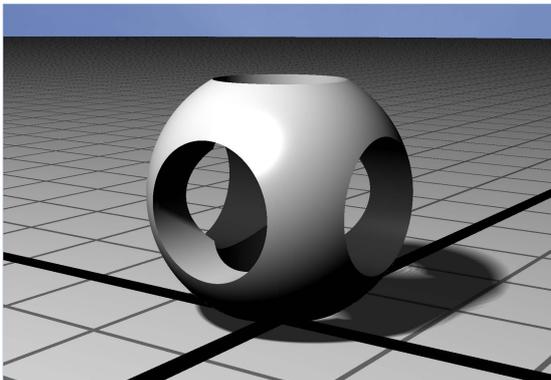


Figure 1: A unit sphere hollowed along each axis by a hole of radius 0.5

Ground plane is for illustration only

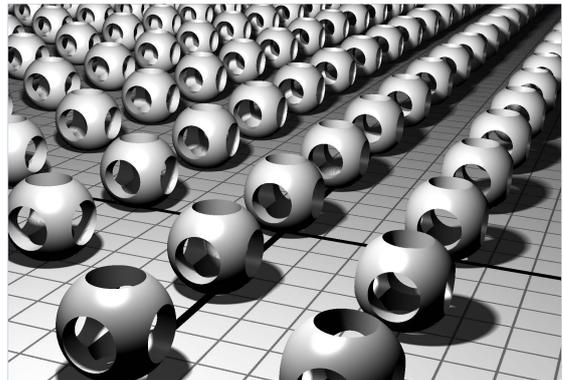


Figure 2: The hollowed unit sphere infinitely repeated in XZ at intervals of 2