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EECS 101
HW 6

1) a) What is the solid angle subtended by the moon as viewed from the earth if we assume the moon to be a sphere of radius R at a distance d?

$$\Omega = \frac{Acos\theta}{R^2}$$

$$\Omega = \frac{(\pi R^2)\cos(0)}{d^2}$$

$$\Omega = \frac{\pi R^2}{d^2}$$

b) What is the range of possible solid angles subtended by a flat circular plate of radius R at a distance d?

$$\Omega = \frac{Acos\theta}{R^2}$$

$$\frac{(\pi R^2)cos(\pi)}{d^2} \leq \Omega \leq \frac{(\pi R^2)cos(0)}{d^2}$$

$$0 \leq \Omega \leq \frac{(\pi R^2)}{d^2}$$

2) Consider a room in the shape of a cube of dimension 100 feet × 100 feet × 100 feet. Consider a square patch of size 1 foot by 1 foot on the ceiling. Suppose that the patch is exactly in the center of the ceiling.

a) What is the solid angle subtended by the square patch as viewed from a corner of the room on the floor?

$$\Omega = \frac{Acos\theta}{R^2}$$

$$\Omega = \frac{(1^2)\frac{100}{\sqrt{15000}}}{(\sqrt{15000})^2}$$

$$\Omega = \frac{100}{15000^{3/2}}$$

b) What is the solid angle subtended by the square patch as viewed from a corner of the room on the ceiling?

$$\Omega = \frac{A\cos\theta}{R^2}$$

$$\Omega = \frac{(1^2)\cos(\pi)}{(\sqrt{15000})^2}$$

$$\Omega = 0$$

3) Consider a Lambertian plane in three dimensions defined by the equation

7x + sqrt(50)y + z + 2 = 0

z = -7x - sqrt(50)y - 2

a) What is the surface gradient (p, q) for the plane?

$$p = \frac{dz}{dx} \quad , \quad q = \frac{dz}{dy}$$

$$p = -7 \quad , \quad q = -\sqrt{50}$$

b) Suppose that the plane is in a dark room with a single point light source. Consider the point
P = (0, 0,−2) on the plane. Determine the location (x, y, z) where we should put the point light source so that the light source is a distance 20 from the point P and the reflected radiance from
P in the direction of (0, 0, 0) is as large as possible.

Normal of given plane

$$n = (7, \sqrt{50}, 1)$$

Plane equation for light source

$$7(x - 20) + \sqrt{50(}y - 20) + z + 2 = 0$$

Point of light source

$$(20, 20, 2)$$

Radiance map equation

$$R(p, q) = \frac{1 + p_s p + q_s q}{\sqrt{1 + {p_s}^2 + {q_s}^2}\sqrt{1 + p^2 + q^2}}$$

Maximum when radiance map equals 1
This is satisfied when both p = ps and q = qs

$$1 = \frac{1 + 49 + 50}{\sqrt{1 + 49 + 50}\sqrt{1 + 49 + 50}}$$

$$1 = 1$$