Tutorial 8: Radiosity

1. *Form factors*:

In a radiosity scene the patches are triangular. Two patches are defined as follows:

Patch	Points		
i	(10, 12, 8)	(10, 13, 8)	(10, 11, 9)
j	(5, 6, 12)	(5, 6, 13)	(8, 6, 12)

Assuming that these two patches are visible from each other calculate the two form factors F_{ij} and F_{ji}. (Use the centroid of each triangle, $\frac{1}{3}(\mathbf{P}_1 + \mathbf{P}_2 + \mathbf{P}_3)$, to estimate the distance)

2. *The Hemicube*:

A hemicube is defined by the top plane $z = 1$ and side planes $x = 1$, $y = 1$, $x = -1$, $y = -1$. Assume that the hemicube pixels all have area ΔA . Derive a formula for the delta form factors of the pixels on the side planes in terms of the distance r of their centre to the origin (Hint: evaluate $\cos\phi$ using a dot product).

3. *The Hemisphere*:

A form factor is to be computed by a ray casting algorithm. Rays are to be cast from the centre of the patch with the aim of finding the nearest patch visible by that ray.

The rays are defined by the spherical polar coordinates (θ, ϕ) and are to be spaced at equal intervals of 1 degree ($\pi/180$ radians) in the range $0 < \theta < 180^\circ$, $0 < \phi < 180^\circ$.

If the rays are thought to pass through a unit hemisphere which is divided into approximately square patches around each ray, derive a formula for the delta form factor for the ray.

4. *r-refinement*:

An r-refinement scheme for a triangular mesh moves each point in the direction of greatest change. Let (**P**, *B*) represent the pairing of a point **P** with a radiosity value of *B*. Let its neighbours be represented by the pairs ($\mathbf{P_1}$, B_1), ($\mathbf{P_2}$, B_2), ($\mathbf{P_3}$, B_3) and ($\mathbf{P_4}$, B_4).

One suggestion for refining the mesh is to find the direction of greatest change by adding up the vectors

$$|B_1 - B|(\mathbf{P}_1 - \mathbf{P}) \quad |B_2 - B|(\mathbf{P}_2 - \mathbf{P}) \quad |B_3 - B|(\mathbf{P}_3 - \mathbf{P}) \quad |B_4 - B|(\mathbf{P}_4 - \mathbf{P})$$

Suggest a way in which the distance each point should be moved. Given the following points:

Point	Coordinate	Radiosity
P	(20, 6, 0)	30
$\mathbf{P_1}$	(10, 10, 0)	50
$\mathbf{P_2}$	(10, 30, 0)	20
$\mathbf{P_3}$	(15, 2, 0)	30
$\mathbf{P_4}$	(10, 0, 0)	50

use your method to determine how to move point **P**