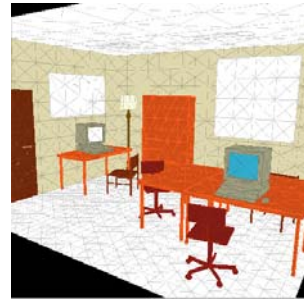


# Radiosity

**CPSC 414**

# Radiosity



[IBM]

# Radiosity



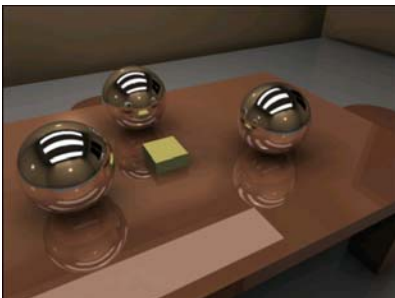
[IBM]

# Radiosity



[electricimage.com]

# Radiosity



[electricimage.com]

# Radiosity



[electricimage.com]

# Radiosity



[electricimage.com]

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# Radiosity Example



**reflectivity**

A	0.8
B	0.8
L	0.85

**emission**

A	0 W
B	0 W
L	100 W

**form factors**  
to

	A	B	L
A	0	0.35	0.05
B	0.3	0	0.06
L	0.25	0.45	0

from

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# Computing an Energy Balance



light leaving = light emitted + light reflected

$$I_L = 100 + 0.85 * (0.05 I_A + 0.06 I_B)$$

$$I_A = 0 + 0.8 * (0.3 I_B + 0.25 I_L)$$

$$I_B = 0 + 0.8 * (0.35 I_A + 0.45 I_L)$$

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# More formally...



- **flux**,  $\mathcal{I}$ : energy per unit time (W)
  - **radiosity**,  $B$ : exiting flux density ( $W/m^2$ )
- flux = radiosity \* area
- $$\mathcal{I} = B * A$$
- $E$ : exiting flux density for light sources ( $W/m^2$ )
  - **reflectivity**,  $R$ : fraction of incoming light reflected

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# More formally...



light leaving surface = emitted light + reflected light

$$B_i A_i = E_i A_i + R_i \sum_j B_j F_{ji} A_j$$

$$B_i = E_i + R_i \sum_j B_j F_{ji} \frac{A_j}{A_i}$$

form-factor reciprocity:

$$F_{ji} A_j = F_{ij} A_i$$

$$B_i = E_i + R_i \sum_j B_j F_{ij}$$

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# More formally (cont.)



$$\begin{bmatrix} E_1 \\ E_2 \\ \dots \\ E_n \end{bmatrix} = \begin{bmatrix} 1-R_1 F_{11} & \dots & -R_1 F_{1n} \\ -R_2 F_{21} & \dots & -R_2 F_{2n} \\ \dots & \dots & \dots \\ -R_n F_{n1} & \dots & -R_n F_{nn} \end{bmatrix} \begin{bmatrix} B_1 \\ B_2 \\ \dots \\ B_n \end{bmatrix}$$

emitted flux density
exiting flux density

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## Issues

- need to solve  $N$  simultaneous equations  
What to do when  $N = 50,000$  ?
  - *use iterative, hierarchical methods*
- form factor computation is costly due to visibility
- need to reconstruct a continuous image from patches
  - *interpolation schemes, non-constant basis*
- curved surfaces?
- sharp shadows?
- specular reflection, translucency, refraction?
  - *hybrid radiosity / ray-tracing techniques*