CS680:
Advanced Computer Graphics
- Scalable Global Illumination Algorithms

Sung-Eui Yoon
(윤성의)

Course URL:
http://jupiter.kaist.ac.kr/~sungeui/SGA/

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About the Instructor

- Joined KAIST at July last year

- B.S., M.S. at Seoul National Univ.
- Ph.D. at Univ. of North Carolina-Chapel Hill
- Post. doc at Lawrence Livermore Nat'l Lab

- Main research focus
  - Handling of massive geometric data for various computer graphics and geometric problems

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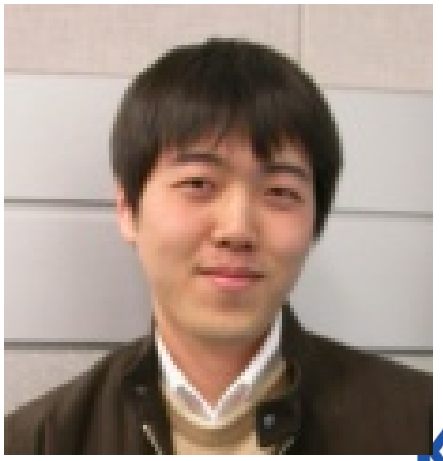
About the Instructor

- **Contact info**
  - **Email: sungeui@gmail.com**
  - **Office: 3432 at CS building**
  - **Homepage: http://jupiter.kaist.ac.kr/~sungeui**

Class Information

- **Class time**
  - **4:00pm ~ 5:30pm on TTh**
- **Office hours**
  - **5:30-6:00pm right after Tue. and Thur. classes at my office**
- **TA**
  - **박정현 (JeongHyeon Park)**
  - **parkjh@tclab.kaist.ac.kr**
  - **Office hour: 2:00~2:30 on TTh**
  - **Room: 3439**



About the Course

- **We will focus on the following things:**
  - **Study various methods for physically-based rendering**
  - **Identify pros and cons of current methods**
  - **Design better technologies as your final project**

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Photo-Realistic Rendering

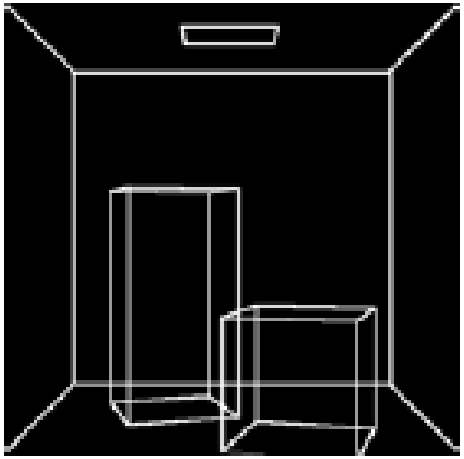
- **Achieved by simulating light and material interactions**

from Prof. Bala's slide

- **Rendering equation**
  - **Mathematical formulation of light and material interactions**

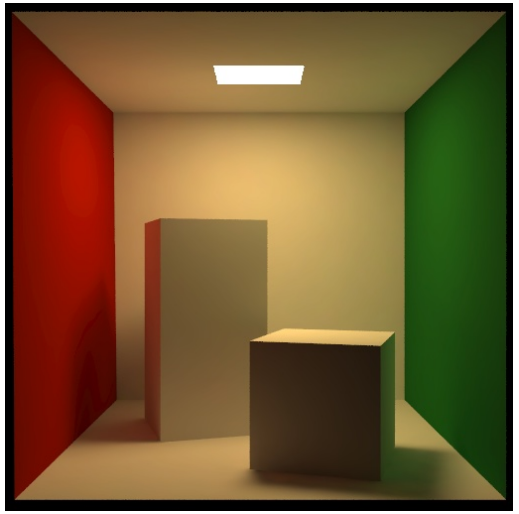
Global Illumination (GI)

- GI algorithms solve the rendering equation
  - Generate 2D image from 3D scene



from Prof. Bala's slide

⇨ **GI Algorithm** ⇨



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Emission (light sources)
Geometry (objects)
BRDF (materials)

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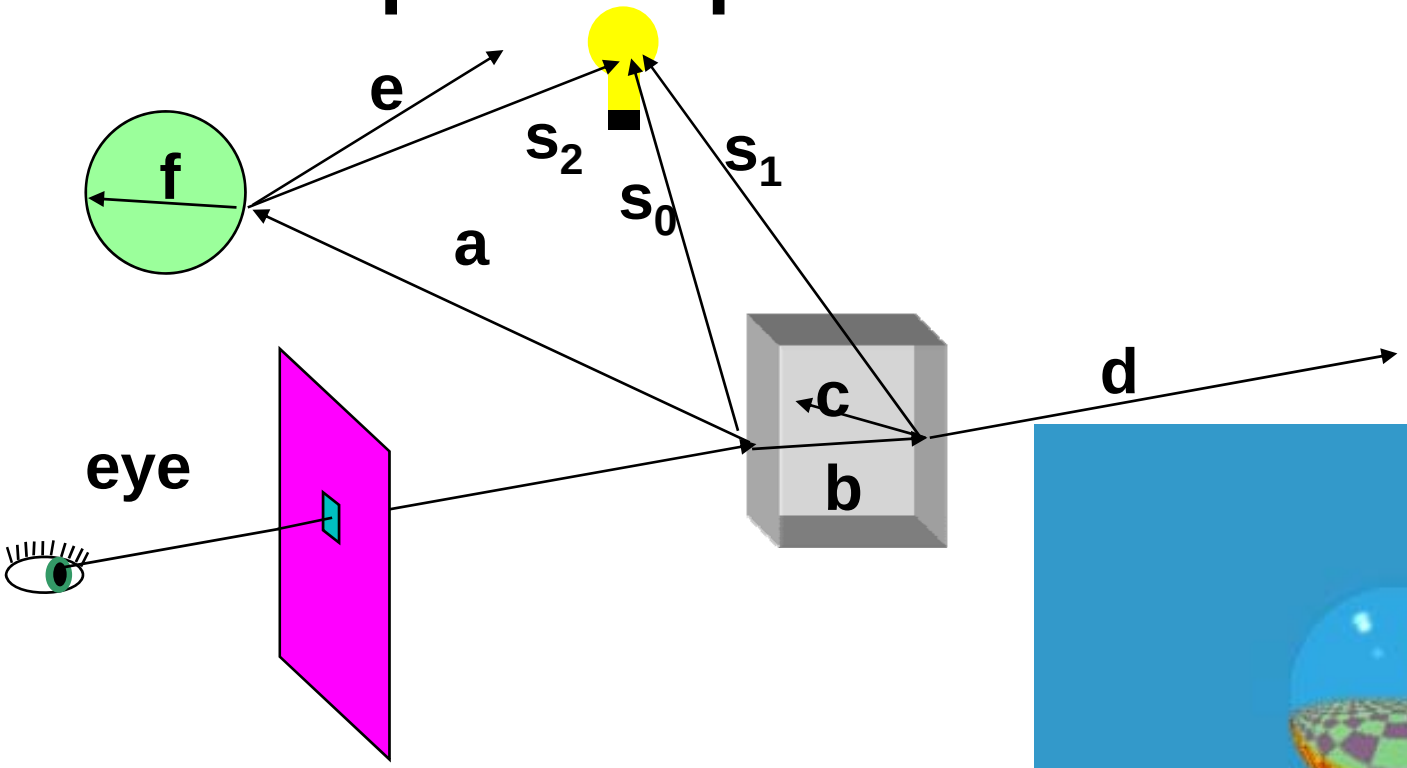
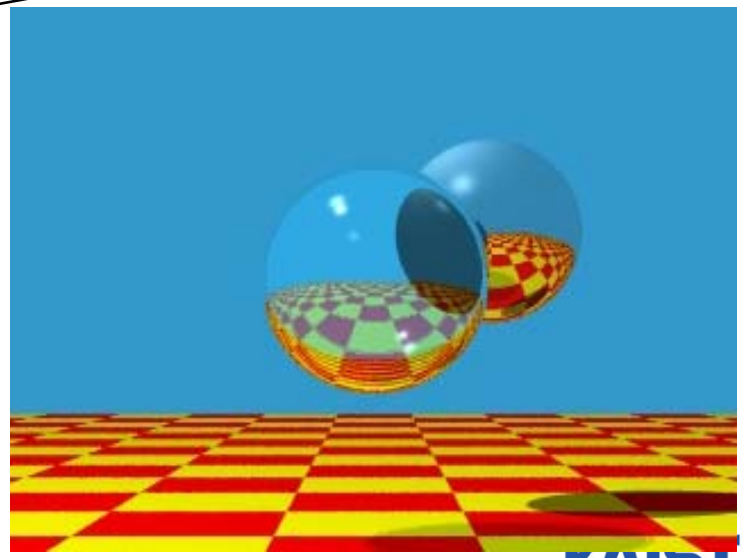
Classic Methods of GI

- Ray tracing
  - Introdued by Whitted in 1980
- Radiosity
  - Introduced in 1984
- Monte Carlo rendering

Ray Tracing

- Assume perfect specular or diffuse material





Radiosity

- **Assume diffuse inter-reflections**

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Advanced Global Illumination

- **Extend to handle more realistic materials than just perfect specular / diffuse**
  - **Classic ray tracing and classic radiosity are basic building blocks**

from photon map paper

from Pixar movie

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Scalable GI

- How can we handle complexity?
  - Many objects
  - Many triangles
  - Many lights
  - Complex BRDFs
  - Dynamic scenes, etc.
- Can we achieve interactive GI on commodity hardware?

Some of Topic Lists

- Ray tracing
- Radiosity
- Rendering equations
- Monte Carlo method
- Levels-of-detail or multi-resolution techniques
- Many light problems
- Coherent ray tracing
- Shadow maps
- Dynamic and massive models
- Precomputed radiance transfer
- Real-time rendering
- Irradiance caching
- Sampling and reconstruction
- Data compression
- Parallel computation
- Realistic rendering

Prerequisites

- **Undergraduate computer graphics**
- **If you are not sure, please consult the instructor at the end of the course**

Course Overview

- 1/3 of lectures and 2/3 of student presentations
  - This is a research-oriented course
  - Reading list containing about 70 papers

- What you will do:
  - Choose a topic from the topic list & read papers related to the topic
  - Present talks explaining the topic to us
  - Propose idea and implement it as a final project
  - Quiz and mid-term
  - and, have fun!

Presentations and Final Project

- **Read papers on a chosen topic**
  - **Look at pros and cons of each method**
  - **Think about how we can efficiently handle more realistic and complex scene**
- **Propose and implement ideas to address those problems**
  - **Prepare a final report**
- **Team project is allowed**
  - **Role of each student should be very clear**

Review Service

- **Let's meet before your in-class presentations**
- **I'll give you comments on your reports and presentations**

Course Awards

- Best speaker and best project
- For the best project, cost for attending the premium conf. (e.g., SIGGRAPH) will be supported
  - Lead author will get it
  - We may not select the best project if the project does not improve the state-of-the-art methods
- For the best presenter, a research equipment will be supported

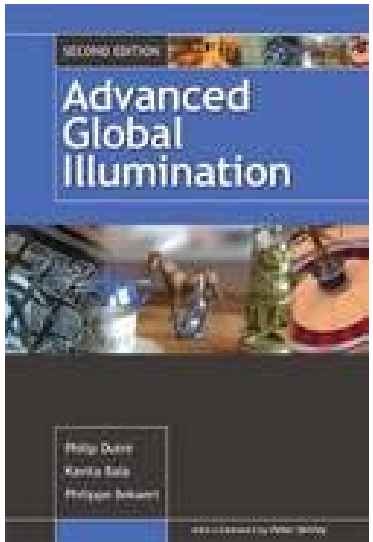
Course Overview

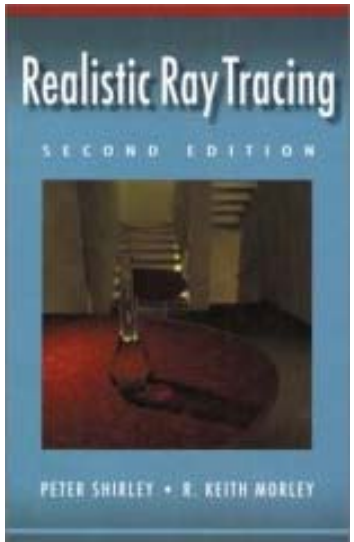
- **Grade policy**
  - **Class presentations: 30%**
  - **Quiz, assignment, and mid-term: 30%**
  - **Final project: 40%**

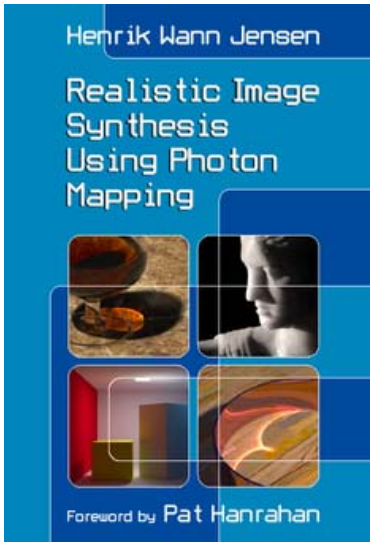
- **Instructor and students will evaluate presentations and projects**
  - **Instructor: 50% weights**
  - **Students: 50% weights**

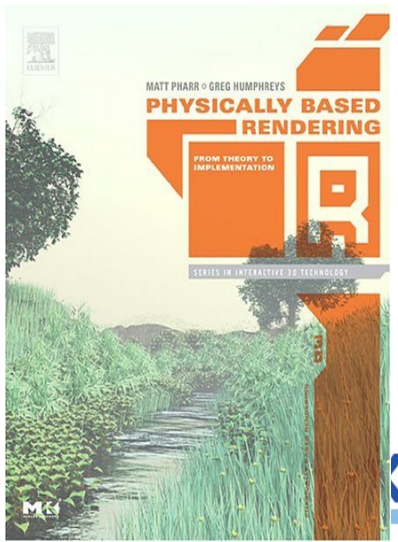
Resource

- **No textbook**
- **Reference**
  - **Advanced Global Illumination, Philip Dutre et al. 2nd edition**
  - **Physically based renderig, Matt Pharr et al.**
  - **Realistic Image Synthesis Using Photon Mapping, Henrik Jensen**
  - **Realistic Ray Tracing, 2nd edition, Peter Shirley et al.**









Other Reference

- Our paper reading list
- SIGGRAPH course notes and video encore
- Technical papers
  - Graphics-related conference (SIGGRAPH, etc)
  - http://kesen.huang.googlepages.com/
- Course homepages
- Google or Google scholar

Honor Code

- **Students are here for the learning not the grade**
  - **Collaboration encouraged, but *assignments must be your own work***
  - **Cite any other's work if you use their code**

Schedule

- **Please refer the course homepage:**
  - **http://jupiter.kaist.ac.kr/~sungeui/SGA/**

Homework

- **Refresh materials that you learned at your undergraduate computer graphics course**
  - **Go over course slides of CS480**
  - **http://sglab.kaist.ac.kr/~sungeui/CG/**

- **There will be a quiz at the next class**

Next Time

- **Ray tracing, radiosity**