
CS482:
Interactive Computer Graphics
- Focus on interactive rendering

Sung-Eui Yoon
(윤성의)

Course URL:
<http://sglab.kaist.ac.kr/~sungeui/ICG>

KAIST



About the Instructor

- **2012~: IEEE Senior member**
- **2011~2012: conf. and program co-chairs of ACM symp. on Interactive 3D Graphics and Games (I3D)**
- **2011~2013: 이원부교수**
- **Joined KAIST at 2007**

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

About the Instructor

- **Contact info**

- **Email: sungeui@gmail.com**
- **Office: 3432 at CS building**
- **Homepage: <http://sglab.kaist.ac.kr/~sungeui>**

Class Information

- **Class time**
 - **1:00pm ~ 2:15pm on TTh**
 - **114 at N1**
- **Office hours**
 - **Right after class**

TA Information

- **Myungbae Son (손명배)**

- **ned society@gmail.com**
- **Office hour: right after the class on Tue**
- **Room: E3-1 #3440**



- **Byungyoon Choi (최병윤)**

- **byungyoonc@gmail.com**
- **Office hour: right after the class on Thr**
- **Room: E3-1 #3443**



Overview

- We will discuss various parts of computer graphics, especially on interactive rendering



Computer vision inverts the process
Image processing deals with images

Applications of Computer Graphics

- **Games**
- **Augmented or virtual reality (AR/VR)**
- **Movies and film special effects**
- **Product design and analysis**
- **Medical applications**
- **Scientific visualization**

Games



2D game



3D shooting game

Game Industry at Korea

- One of biggest IT sectors in Korea

창원에 엔씨소프트 프로야구단 생긴다(종합)



새롭게 창단하는 구단은 모기업의 당기 순이익이 1천억원 이상이거나, ...

KBO 이사회 개최

(서울=연합뉴스) 이상학 기자 =11일 오전 서울 강남구 도곡동 야구회관에서 열린 KBO 이사회에서 유영구 총재가 회의를 주재하고 있다. 8개 구단 사장단이 참석한 가운데 열린 이날 이사회에서는 9구단 승인 여부 등을 논의한다. 2011.1.11 leesh@yna.co.kr

Movies and Film Special Effects



Toy story



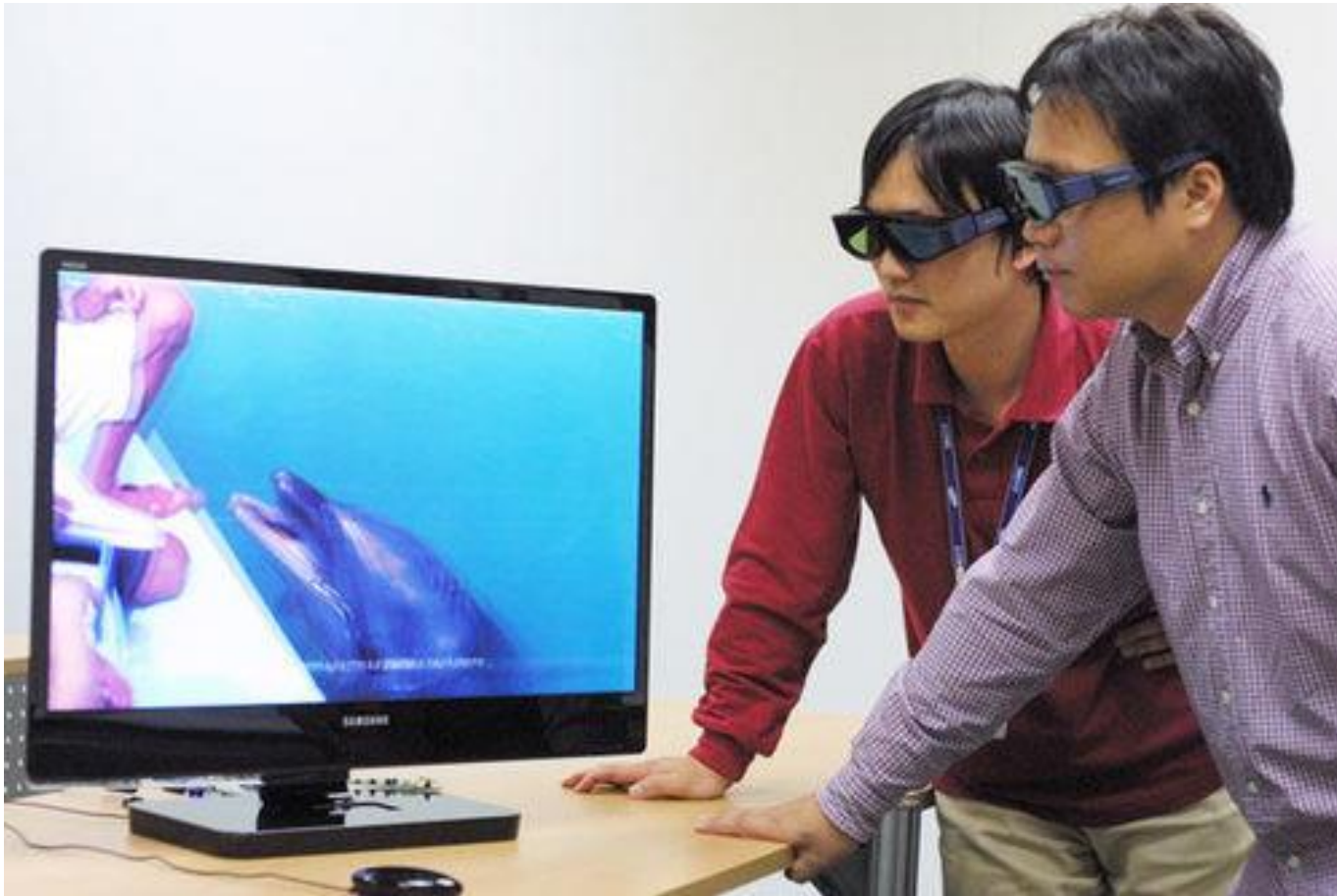
Matrix

3D Movies



Avatar

3D TV



Samsung 3D TV

Head-Mounted Display (HMD) for VR



HoloLens for Augmented Reality (AR)



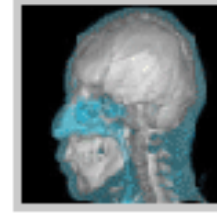
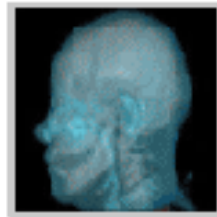
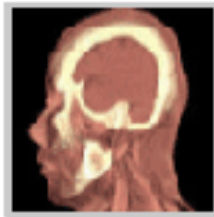
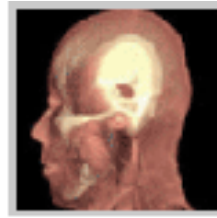
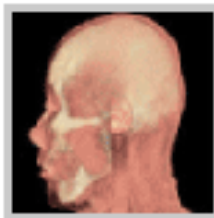
Product Design and Analysis

- **Computer-aided design (CAD)**



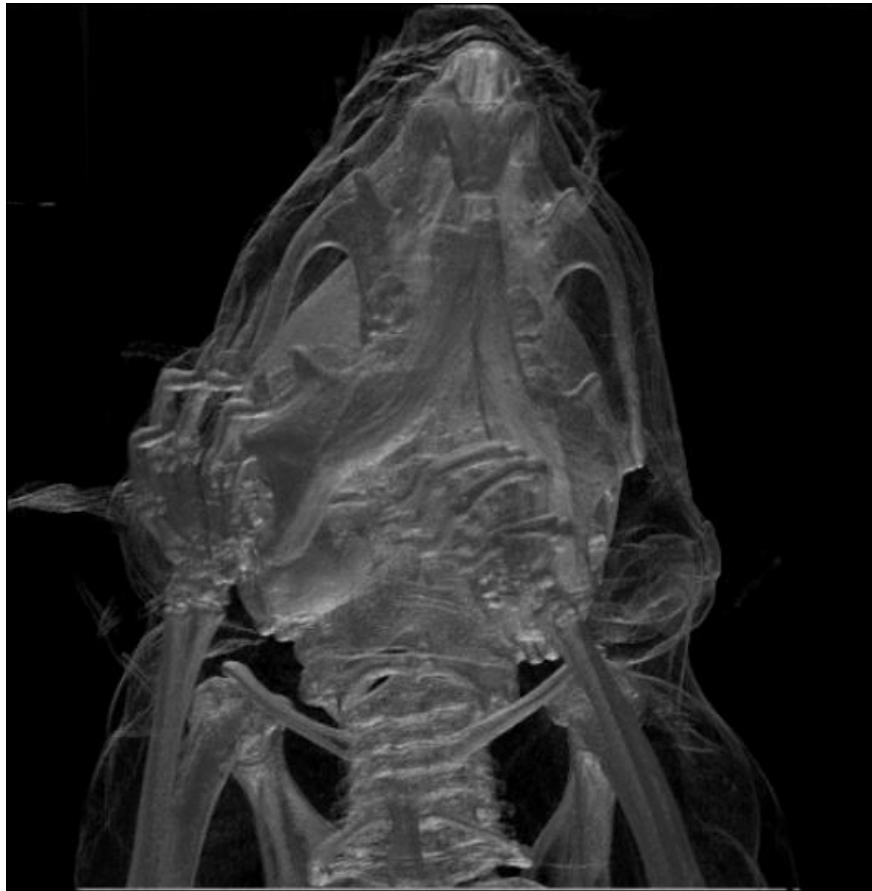
Medical Applications

- Visualizing data of CT, MRI, etc



Medical Applications

- Visualizing data of CT, MRI, etc

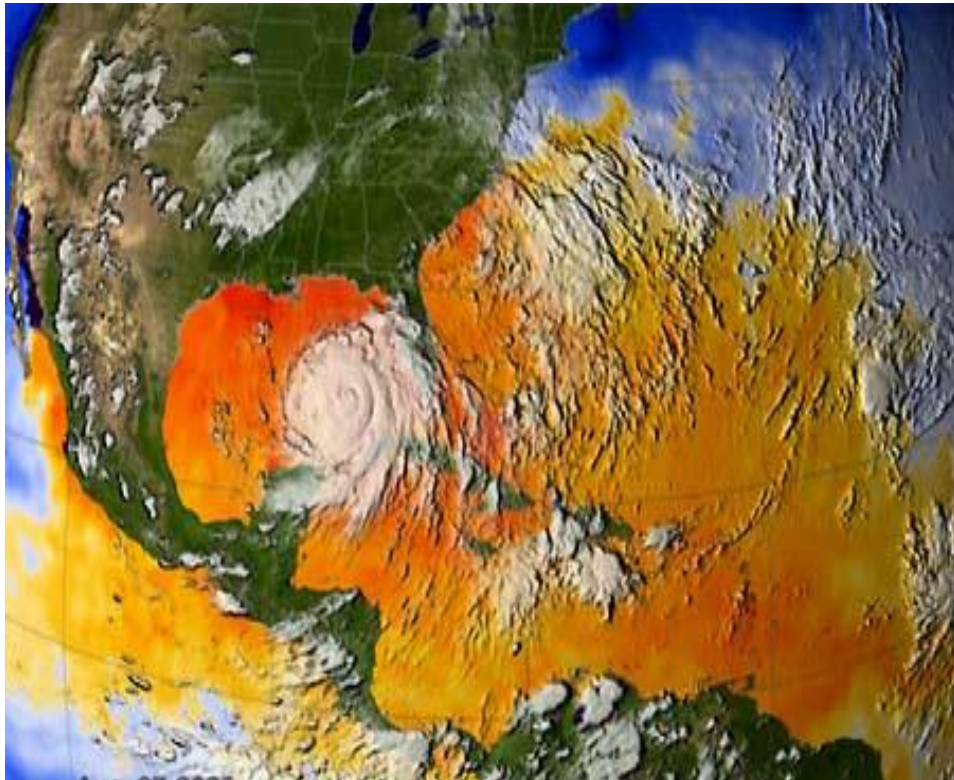


Wikipedia

Mouse skull (CT)

Scientific Applications

- **Weather visualization**



LLNL

About the Course

- **We will focus on the following things:**
 - **Study basic concepts of physically-based rendering**
 - **Focus on interactive rendering techniques for future applications**
 - **Implement a recent technique, and discuss its pros and cons**



Photo-Realistic Rendering

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

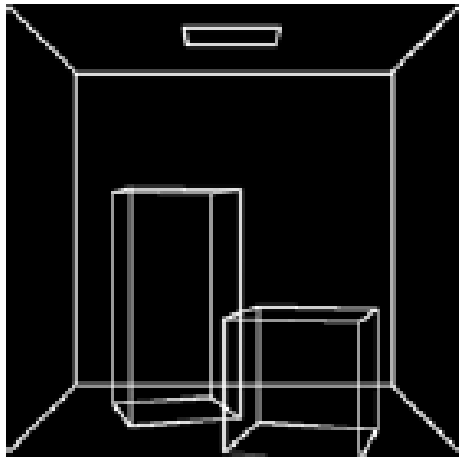


from Prof. Bala's slide

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

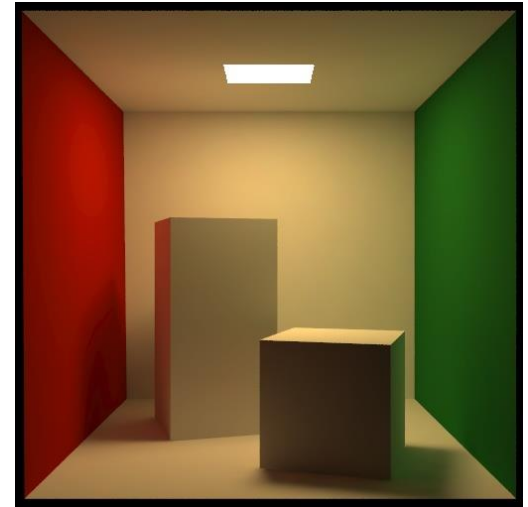
Global Illumination (GI)

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



from Prof. Bala's slide

⇒ **GI
Algorithm** ⇒



+

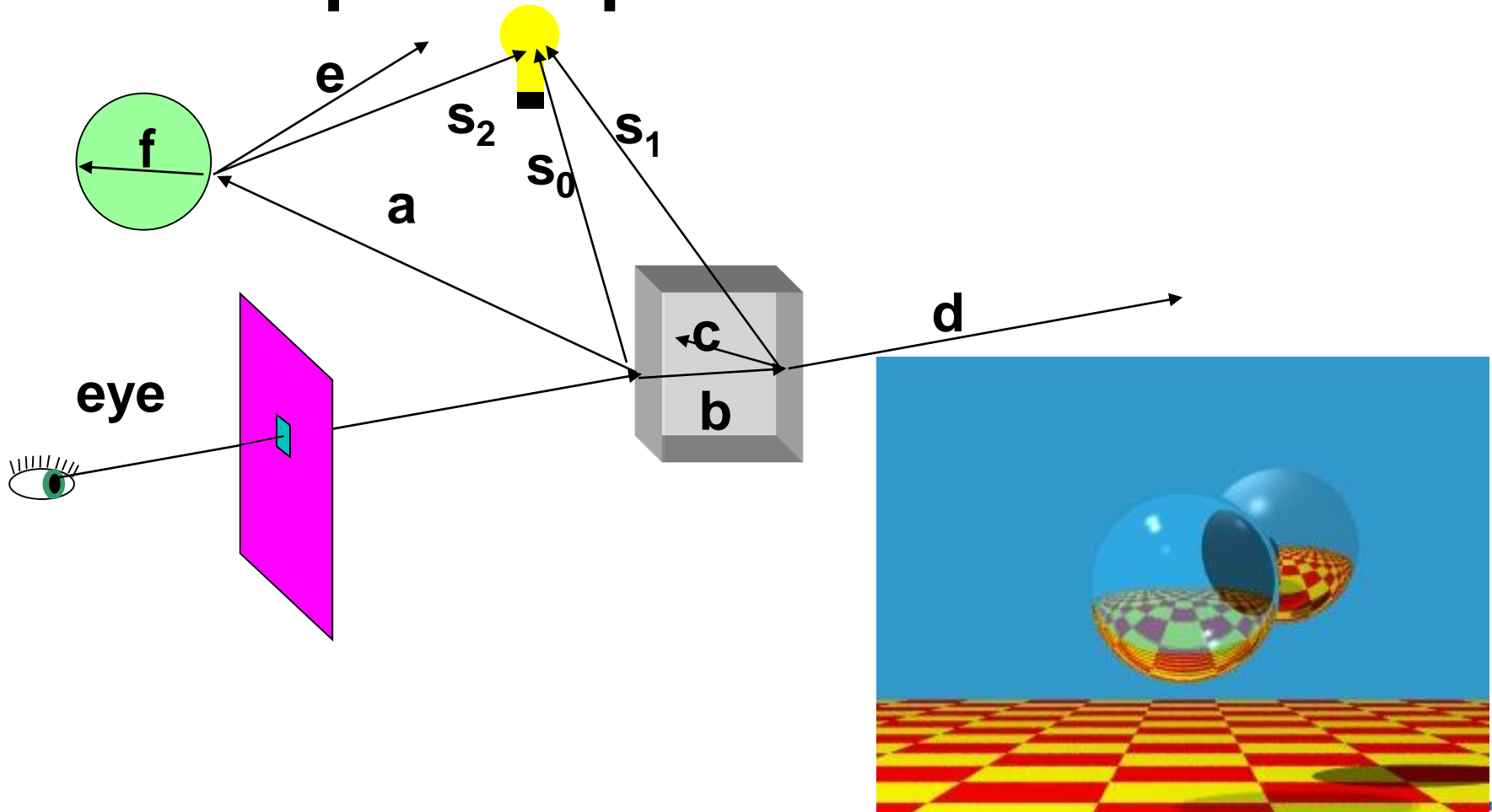
Emission (light sources)
Geometry (objects)
BRDF (materials)

Classic Methods of GI

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

Ray Tracing

- Assume perfect specular or diffuse material



Radiosity

- **Assume diffuse inter-reflections**



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

Interactive 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
- Path tracing
- BRDF
- Rendering equations
- Monte Carlo method
- Textures
- Shadow
- Lighting and shading
- Radiosity
- Instant radiosity
- GPU acceleration
- Sampling and reconstruction
- Realistic rendering
- Interactive ray tracing kernels

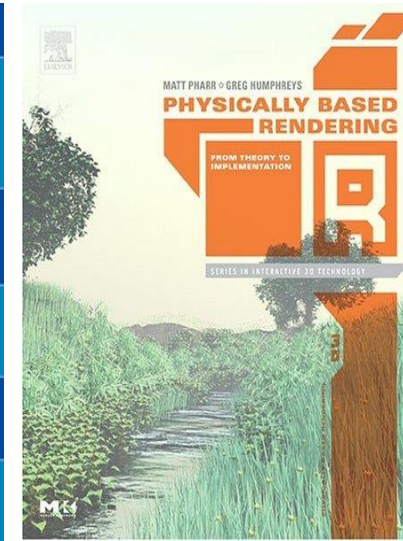
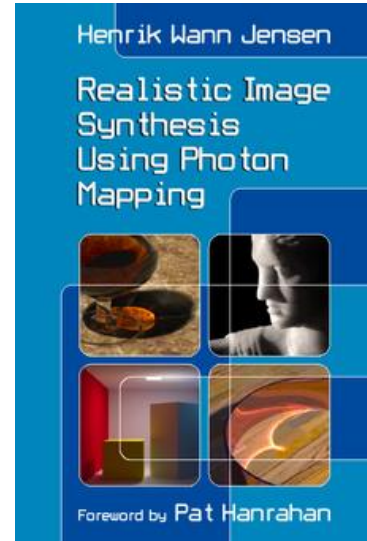
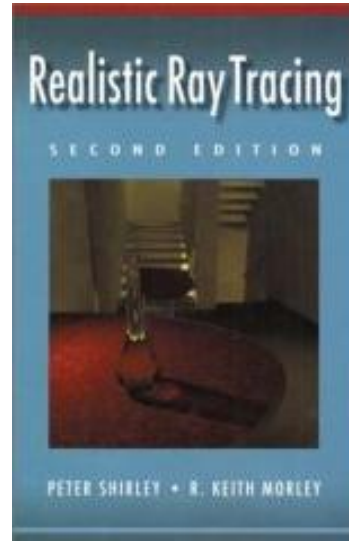
Prerequisites

- **CS380**
- **Basic programming skill**
- **Basic understanding on data structures (e.g., stack) and linear algebra (e.g., matrix multiplication)**

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

Resource

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



Other Reference

- **Technical papers**
 - Graphics-related conference (SIGGRAPH, etc)
 - <http://kesen.huang.googlepages.com/>
- **SIGGRAPH course notes and video encore**
- **I3D and HPG**

- **Course homepages**
- **Google or Google scholar**



Course Overview

- **1/2 of lectures and 1/2 of student presentations**
 - **Mid-term & final-term exams with a few quiz**
 - **A few programming assignments**
 - **A few paper presentations**
 - **Team project**

What you will do

- **Paper presentation and final team project**
 - **Make a team of two or three members**
 - **Choose a topic for the team, and each team member presents a paper related to it**
 - **All the team members implement techniques of a paper and improve them**
 - **Role of each team member should be clear**
 - **Present what the team did for the team project**

Course Awards

- **Best speaker and best project**
 - **Provide small gifts**

Grading

- **Quiz, assignments, and exams: 50%**
- **Class presentations: 25%**
- **Final project: 25%**

- **Late policy**
 - **No score for late submissions**
 - **Submit your work before the deadline!**
- **Instructor and students will evaluate presentations and projects**
 - **Instructor: 50% weights**
 - **Students: 50% weights**

Class Attendance Rule

- **Late two times → count as one absence**
- **Every two absences → lower your grade (e.g., A- → B+)**
- **To check attendance, I'll call your names or take pictures**
- **If you are in situations where you should be late, notify earlier**

Honor Code

- **Collaboration encouraged, but *assignments must be your own work***
- **Cite any other's work if you use their code**
- **Classroom etiquette: help you and your peer to focus on the class**
 - **Turn off cell phones**
 - **Arrive to the class on time**
 - **Avoid private conversations**
 - **Be attentive in class**

Official Language in Class

- **English**
 - **I'll give lectures in English**
 - **I may explain again in Korean if materials are unclear to you**
 - **You are also recommended to use English, but not required**

Schedule

- **Please refer the course homepage:**
 - **<http://sglab.kaist.ac.kr/~sungeui/ICG/>**

Homework for Every Class

- **Go over the next lecture slides**
- **Come up with one question on what we have discussed today and submit at the end of the class**
 - **1 for typical questions**
 - **2 for questions with thoughts or that surprised me**
- **Write a question more than 4 times on Sep./Oct.**
 - **Online submission is available at the course webpage**

My Responses to Those Questions

- **Identify common questions and address them at the Q&A file**
- **Some of questions will be discussed in the class**

- **If you want to know the answer of your question, ask me or TA **on person****
 - **Feel free to ask questions in the class**
- **We are focusing on having good questions!**
 - **All of us are already well trained for answering questions**

Homework

- **Watch 2 SIGGRAPH Videos**
 - **EGSR, HPG and I3D are also possible**
 - **Write their abstracts and submit at the beginning of every Tue. class, or**
 - **Submit it online before the Tue. class**
- **Example of an abstract**
 - **Just one paragraph for each abstract**

Title: XXX XXXX XXXX

Abstract: this video is about accelerating the performance of ray tracing. To achieve its goal, they design a new technique for reordering rays, since by doing so, they can improve the ray coherence and thus improve the overall performance.

About You

- **Name**
- **Your (non hanmail.net) email address**
- **What is your major?**
- **Previous graphics experience**
- **Any questions**

Next Time

- **Ray tracing and radiosity**