CS380: Computer Graphics
Introduction

Sung-Eui Yoon
(윤성의)

Course URL:
http://sglab.kaist.ac.kr/~sungeui/CG
About the Instructor

- Joined KAIST at 2007
- Main Research Focus
  - Handle massive data for various computer graphics and geometric problems
  - Paper and video: [http://sglab.kaist.ac.kr/papers.htm](http://sglab.kaist.ac.kr/papers.htm)
  - YouTube videos: [http://www.youtube.com/user/sglabkaist](http://www.youtube.com/user/sglabkaist)
Course Information of CS380

Instructor: Sung-eui Yoon
Email: sungeui@gmail.com
Office: 3432 at CS building
Office hours: 10:30am~11:30am on MTh or right after class time (or by appt.)
Course webpage: http://sglab.kaist.ac.kr/~sungeui/CG/
Noah discussion page
Class Time

- **Date**: every Mon. and Wed.
  - **Time**: 4:00pm ~ 5:15pm

- **4 credit course**
  - A few (2) OpenGL courses given by TAs
TAs

- Donghyuk Kim (김동혁)
  - Office: 3443
- SeHwan Kim (김세환)
- YoungBum Lee (이영범)

- TA email address
  - cs380ta@gmail.com
Prerequisites

- **Basic knowledge of linear algebra**
  - E.g., matrix multiplication

- **Basic knowledge of programming skill**
  - Preferably with C-like language (e.g., C and C++)

- If you are unsure, consult the instructor at the end of this class
Overview

- We will discuss various parts of computer graphics

Modelling  Simulation & Rendering  Image

Computer vision inverts the process
Image processing deals with images
Application of Computer Graphics

- Games
- 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

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
Product Design and Analysis

- Computer-aided design (CAD)
Medical Applications

- Visualizing data of CT, MRI, etc
Medical Applications

- Visualizing data of CT, MRI, etc

Mouse skull (CT)
Scientific Applications

- Weather visualization

LLNL
Topics

- Mathematical tools
- 3D models and interaction
- Hidden surface removal
- Rasterization
- Lighting and shading
- Shadows
- Texture mapping
- Ray tracing
- Global illumination
- Curves and surfaces
- Simplification and levels of detail
- Collision detection
- Graphics hardware, etc
Mathematical Tools

- Homogeneous coordinates
- Vectors
- Planes
- Frames
- Transformations

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  x' \\
  y'
\end{bmatrix} = \begin{bmatrix}
  \cos \theta & -\sin \theta \\
  \sin \theta & \cos \theta
\end{bmatrix}\begin{bmatrix}
  x \\
  y
\end{bmatrix}
\]
3D Models and Interaction

- Loading and view models
- Picking and selection
- Modeling a trackball
- Virtual reality (VR) is all about interaction
Hidden Surface Removal

- Classic problem
- BSP trees
- Ray casting
- Depth buffering
Rasterization

- Clipping
- Scan conversion
Lighting and Shading

- Flat, gouraud, and phong shading
- Empirical and physically-based illumination models
- BRDFs
Shadows

- Shadow volumes
- Shadow maps

Images courtesy of Stamminger and Drettakis 02
Texture Mapping

- Surface parameterization
- Mipmaps and filtering
- Reflection and environment mapping
Ray Tracing

- Object intersection
- Reflection and refraction
- Depth-of-field, motion blur, glossy reflections, soft shadows
Global Illumination

- Rendering equation
- Path tracing, photon mapping, radiosity

Images courtesy of Caligari (www.caligari.com)
Curves and Surfaces

- Bezier curves and B-splines
- NURBS and subdivision surfaces
- Parametric solids

0-levels 1-level 2-levels 3-levels 4-levels 5-levels
Simplification and LOD

- Levels of detail
- Progressive meshes

82 million triangles
Graphics Hardware

- History
- Architecture
- Shading languages
- Future
Animation

- Keyframing
- Parameteric splines
- Motion capture
- Simulation
Textbook

- **Fundamentals of Computer Graphics**
  - 1st Edition
  - 2nd Edition
  - 3rd Edition
  - Peter Shirley et al.
  - AK Peters

- Ordered in KAIST bookstore & library
Textbook – OpenGL

- OpenGL Programming Guide
  - Addison-Wesley Professional
- Version 1.1 is available at internet and the course webpage

- Reference book is also available
  http://www.glprogramming.com/blue
Other Reference

- Technical papers
  - Graphics-related conference (SIGGRAPH, etc)
  - http://kesen.huang.googlepages.com/

- Course homepages
- Google or Google scholar
Program Assignments (PAs)

- PAs (broken into 7 parts)
  - Viewing and manipulating 3D models with OpenGL
  - Rasterization and clipping
  - Texture mapping and lighting
  - Raytracing
  - Etc.

- My philosophy
  - The load of each PA should not be too high, but these assignments cover most major parts of the course
Grading

- **Mid-term**: 20%
- **Final-term**: 30%
- **Quiz and assignments**: 50%

**Late policy**
- No score for late submissions
- Submit your work before the deadline!
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 codes
  - If you copy someone else’s codes, you will get F
  - We will use a code copy checking tool to find any copy
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
Other Related Courses

- **CS580** (Graduate-level introductory CG, Spring semester)
  - Focus on high quality rendering, which will be briefly touched at the end of CS380
  - Undergraduate students can take the course
- **CS380** (Spring semester)
- **CS482** (Fall semester)
  - Focus on advanced, real-time rendering techniques
- All the courses will be given among me, Prof. Park, and Prof. Kim.
Homework for Each Class

- Go over the next lecture slides before the class
  - Just 10 min ~ 20 min for this should be okay
Next Time...

- Screen & world space
- Basic OpenGL usage
About You

- Name
- What is your major?
- Previous graphics experience
- Any questions?