Lecture 1: Overview of Computer Graphics
Welcome!
Instructor

- Lingqi Yan
  - Pronunciation: ling—chi—yen
  - Assistant Professor @ UCSB
    - Ph.D @ UC Berkeley
      - B.E. @ Tsinghua University
  - Website: www.cs.ucsb.edu/~lingqi/
  - Research: Rendering in Computer Graphics
  - Hobbies: research, video games, piano, traveling, NBA, etc.
Instructor’s Achievements

2018: Oscar Nominee for Best Visual Effects

2019: research 2017 widely adopted in Lion King HD

2019: six APEX champions in an evening collaborated with Adobe
Course Staff

• Teaching Assistants
  - Yaoyi Bai, yaoyibai@cs.ucsb.edu
  - Göksu Güvendiren, goksu@cs.ucsb.edu

Göksu Güvendiren

Yaoyi Bai
Today’s Topics

• What is Computer Graphics?

• Why study Computer Graphics?

• Course Topics

• Course Logistics
What is Computer Graphics?

**com•put•er graph•ics** /kəmˈpyʊtər ˈɡrɑːfɪks/ n.
The use of computers to synthesize and manipulate visual information.
Today’s Topics

• What is Computer Graphics?

• Why study Computer Graphics?
  - Applications
  - Fundamental Intellectual Challenges
  - Technical Challenges

• Course Topics

• Course Logistics
Video Games

Sekiro: Shadows Die twice (2019 Game of the Year)
Video Games
Movies

The Matrix (1999)
Movies

The Matrix (1999)

Avatar (2009)
Movies

The Lion King (2019)
Animations

Zootopia (2016)
Animations

Frozen 2 (2019)
Design

Autodesk Gallery

CG

Photo

Autodesk Gallery
Design

Ikea - 75% of catalog is rendered imagery
Visualization

Science, engineering, medicine, journalism, etc.
Virtual Reality
Augmented Reality

Microsoft Hololens
Digital Illustration

https://www.youtube.com/watch?v=HEdRLlqdgA4
Simulation

The Dust Bowl phenomena

Black hole from Interstellar
Graphical User Interfaces
The font Baskerville
Why Study Computer Graphics?

• Fundamental Intellectual Challenges
  - Creates and interacts with realistic virtual world
  - Requires understanding of all aspects of physical world
  - New computing methods, displays, technologies
Why Study Computer Graphics?

- Technical Challenges
  - Math of (perspective) projections, curves, surfaces
  - Physics of lighting and shading
  - 3D graphics software programming and hardware
Why Study Computer Graphics?

• Forget about the previous reasons

Computer Graphics is AWESOME!
Questions?
Today’s Topics

• What is Computer Graphics?

• Why study Computer Graphics?

• Course Topics (mainly 4 parts)
  - Rasterization
  - Curves and Meshes
  - Ray Tracing
  - Animation / Simulation

• Course Logistics
Rasterization

- Project **geometry primitives** (3D triangles / polygons) onto the screen
- Break projected primitives into **fragments** (pixels)
- Gold standard in Video Games (Real-time Applications)

http://vispy.org/modern-gl.html

https://commons.wikimedia.org/wiki/File:Rasterisation-triangle_example.svg
Curves and Meshes

- How to represent geometry in Computer Graphics

Bezier Curve
https://en.wikipedia.org/wiki/B%C3%A9zier_curve

Catmull-Clark subdivision
https://commons.wikimedia.org/wiki/
File:Catmull-Clark_subdivision_of_4_planes.png
Ray Tracing

• Shoot rays from the camera though each pixel
  - Calculate intersection and shading
  - Continue to bounce the rays till they hit light sources

• Gold standard in Animations / Movies (Offline Applications)

Animation / Simulation

• Key frame Animation

• Mass-spring System

https://cs184.eecs.berkeley.edu/sp18/lecture/simulation/slide_010
CS180 is **NOT** about

- 3D modeling using Maya / 3DS MAX / Blender, or VR / game development using Unity / Unreal Engine (where can I learn them?)

Modeling character animation in Maya  

CSGO PoV Cam set up in Unreal Engine  
[https://www.youtube.com/watch?v=3TQ18SmQSw0]
CS180 is NOT about

- Computer Vision / Deep Learning topics, e.g. XYZ-GAN (where can I learn them?)

Semantic Segmentation
https://modeldepot.io/oandrienko/icnet-for-fast-segmentation

GAN 2.0: NVIDIA’s face generator (both are fake)
Questions?
Today’s Topics

• What is Computer Graphics?
• Why study Computer Graphics?
• Course Topics
  • Course Logistics
General Information

• Modern Course
  - Comprehensive but without hardware programming!
  - Pace / contents subject to change

• Course Website
  - Has all the needed information
  - Syllabus, slides, reading materials, etc.
References

- No Required Textbooks
  - Reading materials (if any) will available online before lectures
  - Lecture slides will be available after class

- Most recommended reference
Q & A

• Sign up on Piazza for discussion
  - https://piazza.com/class/k4rn53lpf536ky

• Instructor’s Office hour
  - Tuesdays 2PM - 3PM, HFH 2119

• Office hour
  - Yaoyi Bai
    Fridays 4PM - 5PM, HFH 5110
  - Göksu Güvendiren
    TBD
  - Debugging requests are strongly discouraged
Assignments and Exams

• Assignments
  - Mostly programming tasks with provided code skeletons and virtual machine image
  - Weekly (8% each, usually no more than 20 lines of code per week)
  - Language: C++

• Grading
  - Submit your project by 11:59PM on/before the due dates via Gauchospace
  - Each late day = 10% off
Assignments and Exams

• Exam
  - Only one Midterm (Feb 13), 18%
  - In class, written only
  - No other exams, no finals

• Course Project / Final Project
  - From after the midterm to the end of this quarter, 18%
  - Work in groups of 2 or 3
  - References will be provided, but you decide the topic
  - Show off your work in class (Mar 12)
Academic integrity

• Work alone for regular assignments
  - no copy-pasting from any other sources

• Do not publish your code (on Github, etc.)

• Do not post your solution to Piazza
  - Discussion / explanation is welcomed
Waitlist Policy

• If you are on the waitlist
  - Just attend the lectures
  - Let me know after the Jan 16 lecture

• For exchange students / anyone who need my signature to enroll
  - Talk to Katie Rosenthal (Undergraduate Program Coordinator) first (krosenthal@cs.ucsb.edu, HFH 2104)
  - Then send me an email cc’ing Katie
  - I’ll sign when both Katie and I agree
Questions?
This Week

• No Sections this week
  - But we have C++ review next week

• I have office Hour today
  - Yaoyi and Goksu will have office hour this week

• Next Lecture on Thursday:
  - Review Linear Algebra
    (Vectors, matrices and their computation)
Thank you!