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
  - Yifan Qiao, yifanqiao@ucsb.edu
  - Kalyan Garapaty, kalyan@ucsb.edu
  - Subramaniyam Shankar, subramaniyam@ucsb.edu
Today’s Topics

• What is Computer Graphics?

• Why study Computer Graphics?

• Course Topics

• Course Logistics
What is Computer Graphics?

computer graphics /kəmˈpɪtər 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

Golf The Last of Us Part II (2020 Game of the Year)
Final Fantasy VII Remake (2020)
Movies

The Matrix (1999)
Movies

Avatar (2009)
Animations

Zootopia (2016, Disney)
Animations

Soul (2020, Pixar)
Design

CG

Photo

Autodesk Gallery
Ikea - 75% of catalog is rendered imagery
Visualization

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

Oculus Quest 2
Augmented Reality

Microsoft Hololens
Digital Illustration

https://www.youtube.com/watch?v=minEdRLlqdgA4
Simulation

The Dust Bowl phenomena

Black hole from Interstellar
Graphical User Interfaces
Typography

The Quick Brown Fox Jumps Over The Lazy Dog

```
ABCDEFGHJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz 01234567890
```

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!
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)
Today’s Topics

• What is Computer Graphics?

• Why study Computer Graphics?

• Course Topics

  • Course Logistics
General Information

• Modern Course
  - Comprehensive but without hardware programming!

• 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
  - Link on the course website

• Instructor’s office hour
  - Tuesdays 9 AM - 10 AM Pacific Time
  - Join via zoom: link on the course website
  - No debugging

• TA-s’ office hours TBD
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 11:59 PM Anywhere on Earth on/before the due dates via Gauchospace
  - Each late day = 10% off
Assignments and Exams

• Exam
  - Only a late midterm (Feb 16), 18%
  - Due to COVID-19: Conducted remotely
  - No other exams, no finals

• Course Project / Final Project
  - From after the midterm to the end of this quarter, 18%
  - Due to COVID-19: Work alone
  - References will be provided, but you decide the topic
Academic integrity

• Work alone for assignments and the project
  - no copy-pasting from any other sources

• Do not publish your code (on Github, etc.)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

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

• If you are on the waitlist
  - Let me know asap
  - Just attend the lectures
  - Will be resolved next week

• No cross enrollment allowed
  - If you are an undergraduate student, CS180 only
  - If you are a graduate student, CS280 only
  - Let me know asap if you have enrolled the wrong class
This Week

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

• No office hours

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