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: video games, piano and NBA
Course Staff

• Teaching Assistants
  - Göksu Güvendiren, goksu@ucsb.edu
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Göksu Güvendiren
Lei Xu
Today’s Topics

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

**computer graphics** /ˈkəmˌpyʊtər 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)
Video Games

Apex Legends (2019)
Movies

The Matrix (1999)
Movies

Avatar (2009)
Animations

Zootopia (2016)
Design

CG

Photo

Autodesk Gallary
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=vEdRLlqdgA4
Simulation

The Dust Bowl phenomena  Black hole from Interstellar
Graphical User Interfaces
Typography

The Quick Brown Fox Jumped Over The Lazy Dog

ABCDEFGHJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz 01234567890

Baskerville

credit: Randall Branding
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

• Technical Challenges
  - Math of (perspective) projections, curves, surfaces
  - Physics of lighting and shading
  - 3D graphics software programming and hardware
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

Beziers 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

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• Why study Computer Graphics?

• Course Topics

• Course Logistics
General Information

• New Course
  - First intro to Graphics course ever 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

• Recommended book
Q & A

• Sign up on Piazza for discussion
  - https://piazza.com/class/jtqc9g499j86ja

• Instructor’s Office hour
  - Mondays 2PM - 3PM, HFH 5102

• Office hour
  - Göksu Güvendiren
    Tuesdays 11AM - 12PM, CS Trailers
  - Lei Xu
    Wednesdays 1PM - 2PM, CS Trailers
  - Debugging requests will be denied
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

• Exams
  - Midterm (May 8) and Final (Jun 8), 18% each
  - In class, written only
Academic integrity

- Work alone (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
Questions?
This Week

• No Section today
  - But we have C++ review next Monday

• No Office Hour today
  - Goksu and Lei will have office hour this week

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