

Real-Time High Quality Rendering

GAMES202, Lingqi Yan, UC Santa Barbara

Lecture 1: Introduction and Overview



Welcome!



Logo created by Junqiu Zhu

Welcome!



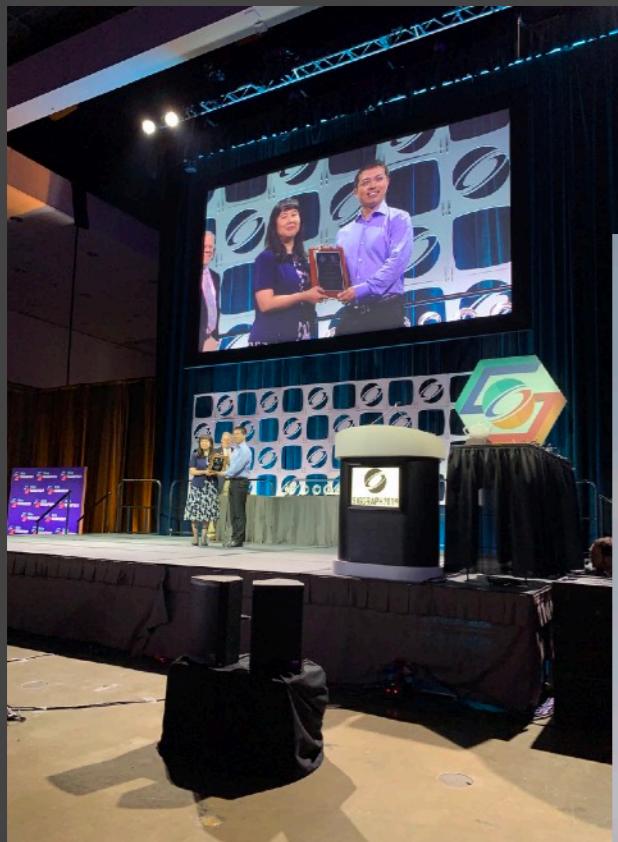
Cyberpunk 2077

Instructor

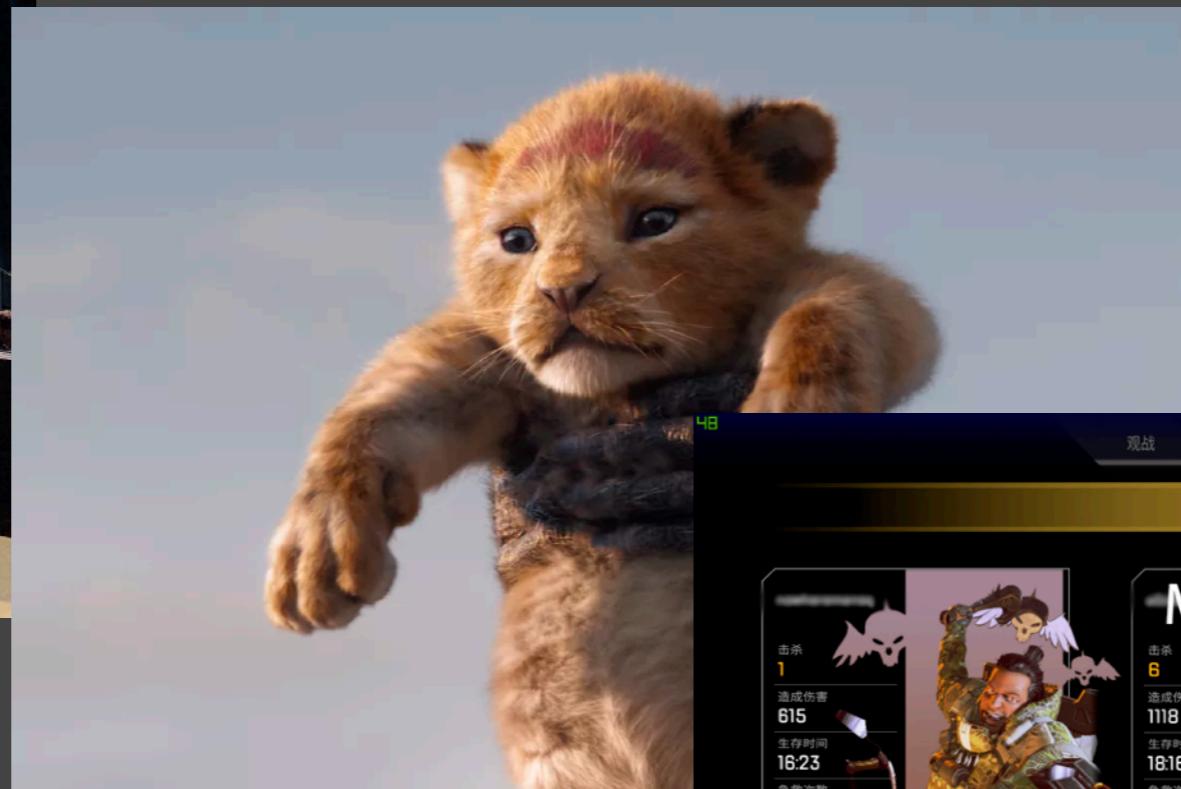
- Lingqi Yan
 - Assistant Professor @ UCSB
 - Web: www.cs.ucsb.edu/~lingqi/
Email: lingqi@cs.ucsb.edu
 - Research: Rendering in Computer Graphics
 - Hobbies: research, video games, piano, NBA, traveling, etc.



Instructor's Achievements



2019: ACM SIGGRAPH
Outstanding Doctoral
Dissertation Award



2019: Oscar Nominee
for Best Visual Effects



2019: six APEX Champions in one evening

Course Staff

- Teaching Assistants
 - 万健洲 (wanjianzhou@qq.com)
 - 周锦超 (zhoujinchao@buaa.edu.cn)
 - 邓俊辰 (junchendeng@gmail.com)
- More will be recruited **from current students** (based on need)

About this Course

What is GAMES202 about?

Real-Time High Quality Rendering

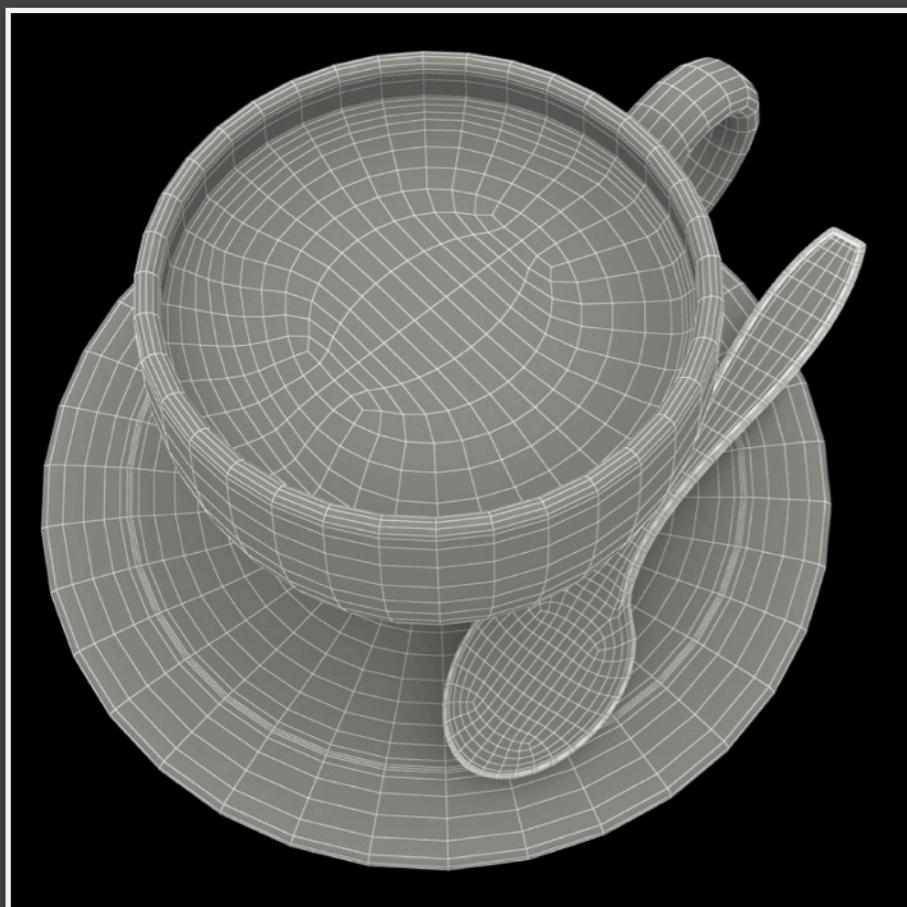
Intermediate level — connecting basic knowledge and research

What is GAMES202 about?

- **Real-Time High Quality Rendering**
 - Speed: more than **30 FPS** (frames per second), even more for Virtual / Augmented Reality (VR / AR): 90 FPS
 - Interactivity: Each frame generated **on the fly**
- **Real-Time High Quality Rendering**
 - Realism: advanced approaches to make rendering more realistic
 - Dependability: all-time **correctness** (exact or approximate), no tolerance to (uncontrollable) failures

What is GAMES202 about?

- Real-Time High Quality **Rendering**
 - What is Rendering?



3D scene (meshes, lights, etc.)

Calculating
light -> eye



Image

What is GAMES202 about?

- Highest level: 4 different parts on real-time rendering

Shadows
(and env)



Physically-
based
Shading



Global Illum.
(Scene/image space,
precomputed)



Real-time
ray tracing



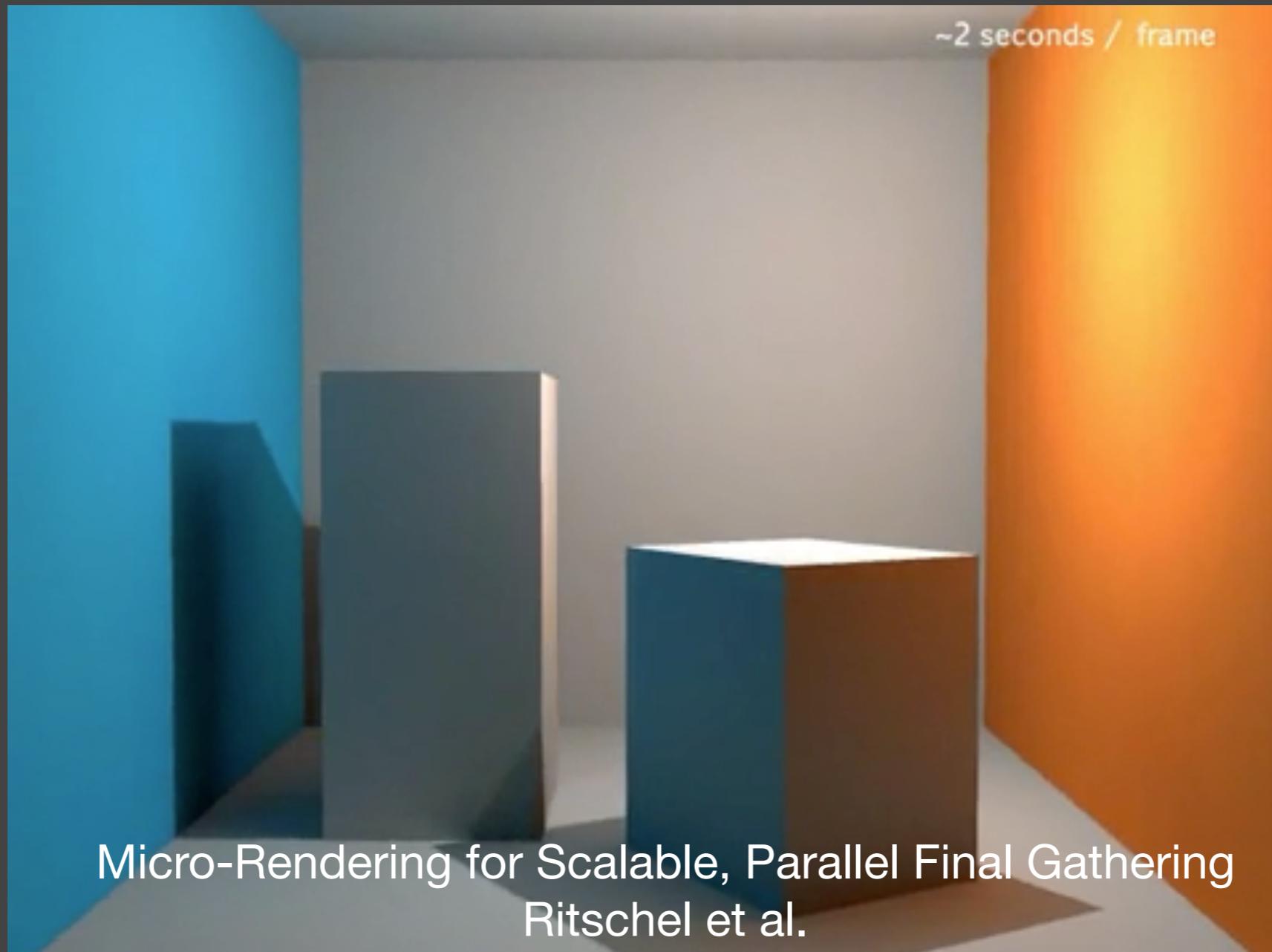
Course Topics

- Shadow and Environment Mapping



Course Topics

- Interactive Global Illumination Techniques



Course Topics

- Precomputed Radiance Transfer



Course Topics

- Real-Time Ray Tracing



Course Topics

- Participating Media Rendering, Image Space Effects, etc.



Single scattering



Image space reflection

Course Topics

- Non-Photorealistic Rendering
 - But will not be in depth / per game



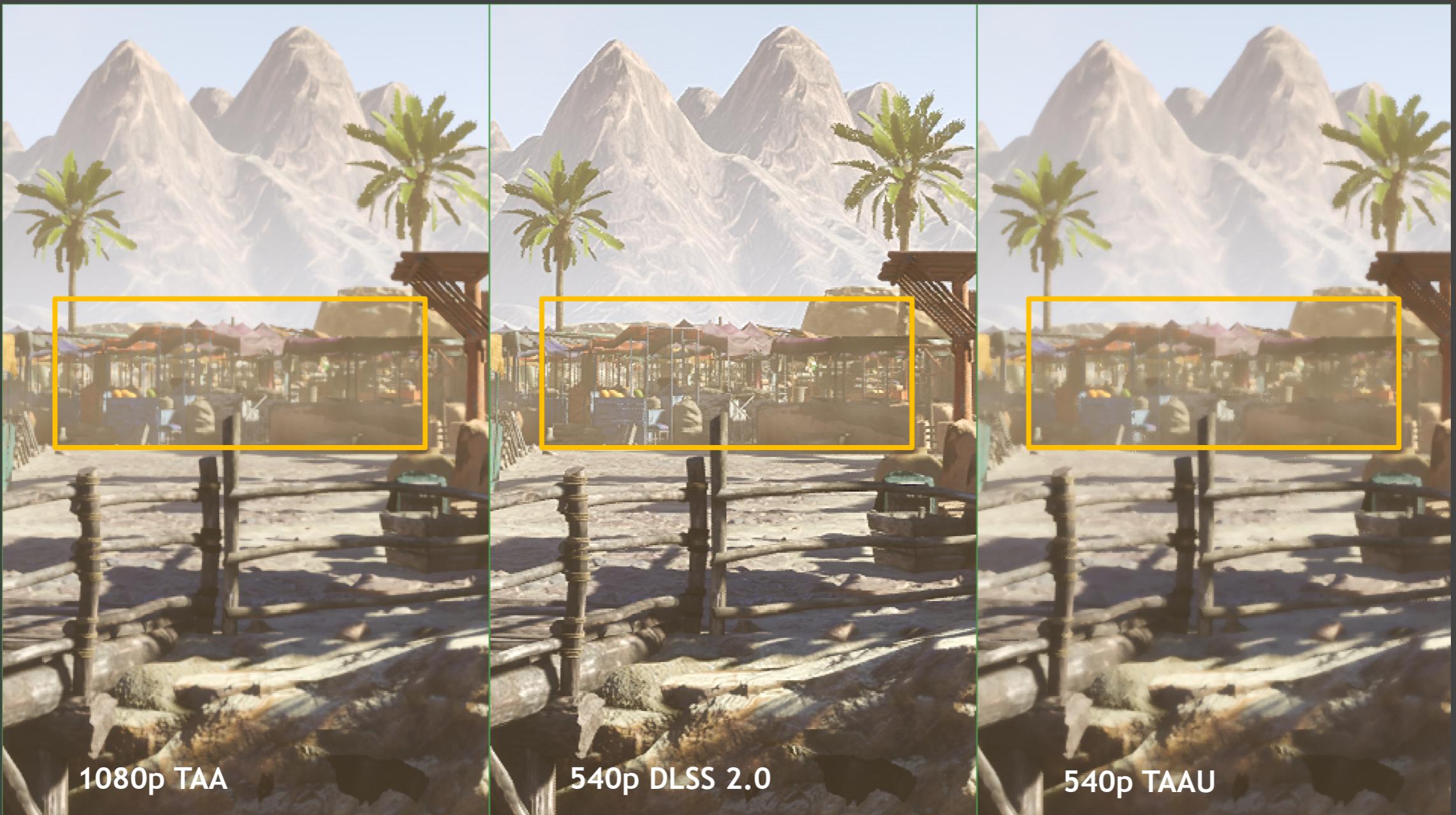
Genshin Impact



Animal Crossing: New Horizons

Course Topics

- Antialiasing and supersampling



Course Topics

- Chatting about techs!

A dark, atmospheric scene from a video game, likely Unreal Engine 5, showing a rocky landscape with a bright opening in the distance.

Unreal Engine 5 Demo

Course Topics

- Chatting about games!



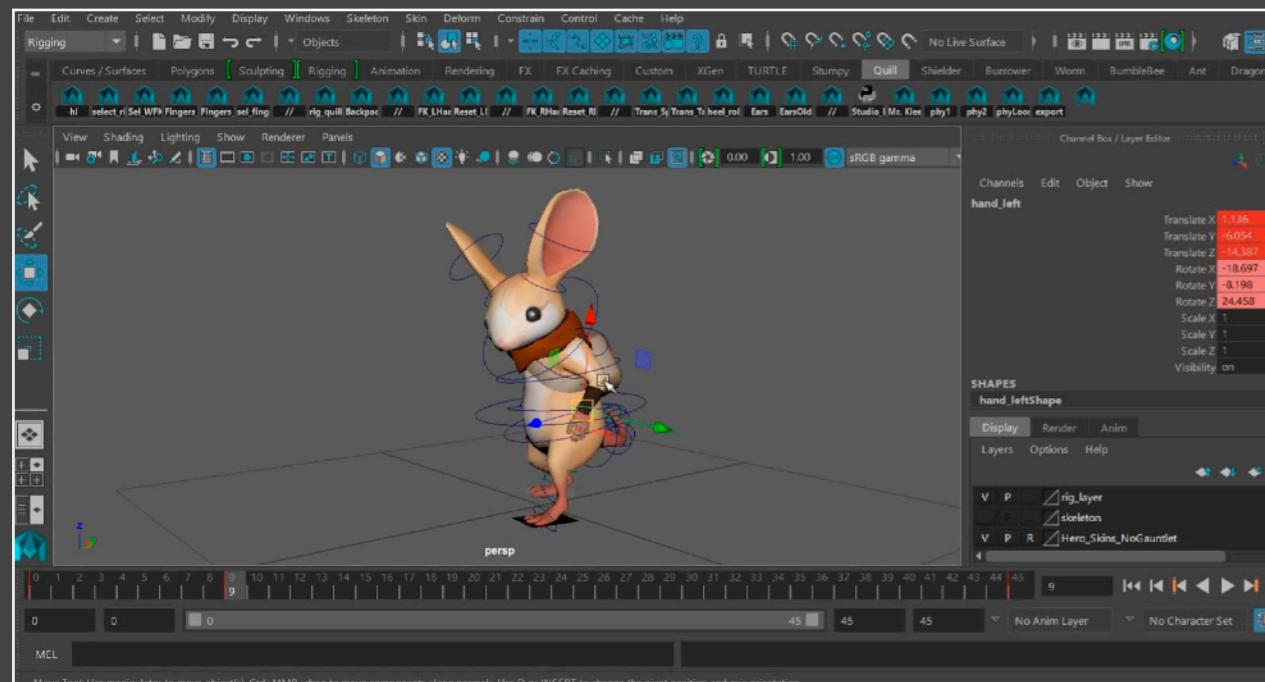
Golf II
The Last of Us Part II
(2020 Game of the Year)



Monster Hunter Rise
(2021)

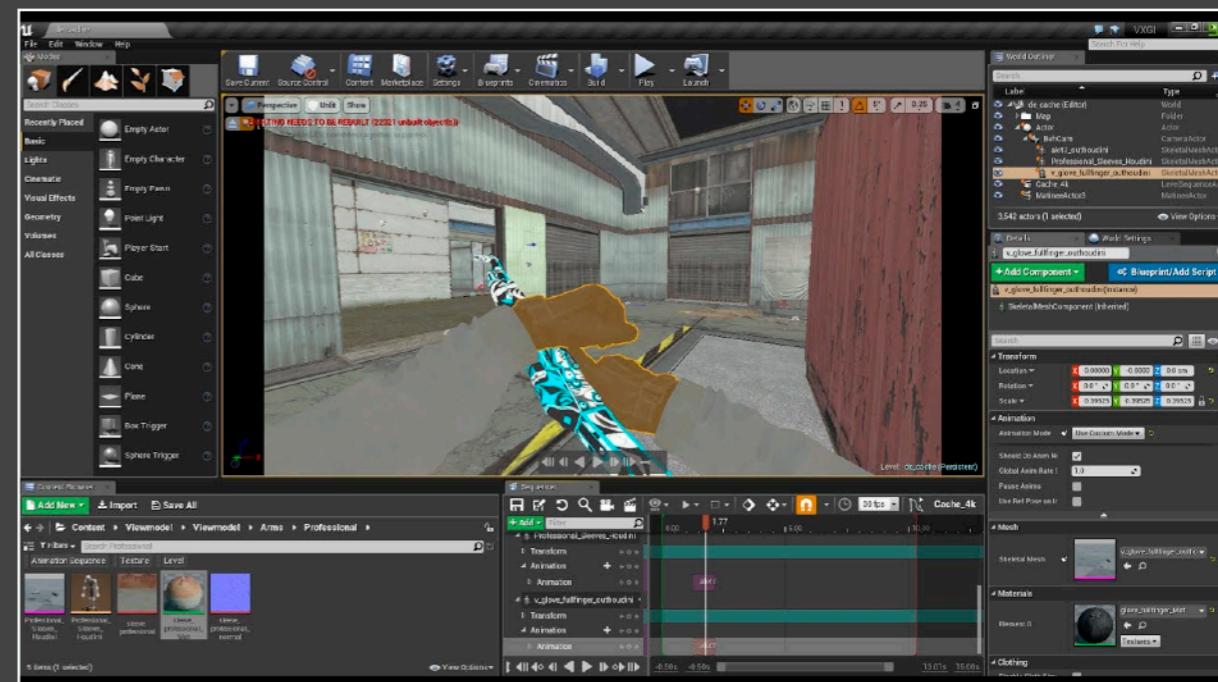
What is GAMES202 NOT about?

- 3D modeling or game development using Unreal Engine
(where can I learn them?)



Modeling character animation in Maya

[<http://tutorials.cgrecord.net/2017/08/17-minute-animation-process-in-autodesk.html>]

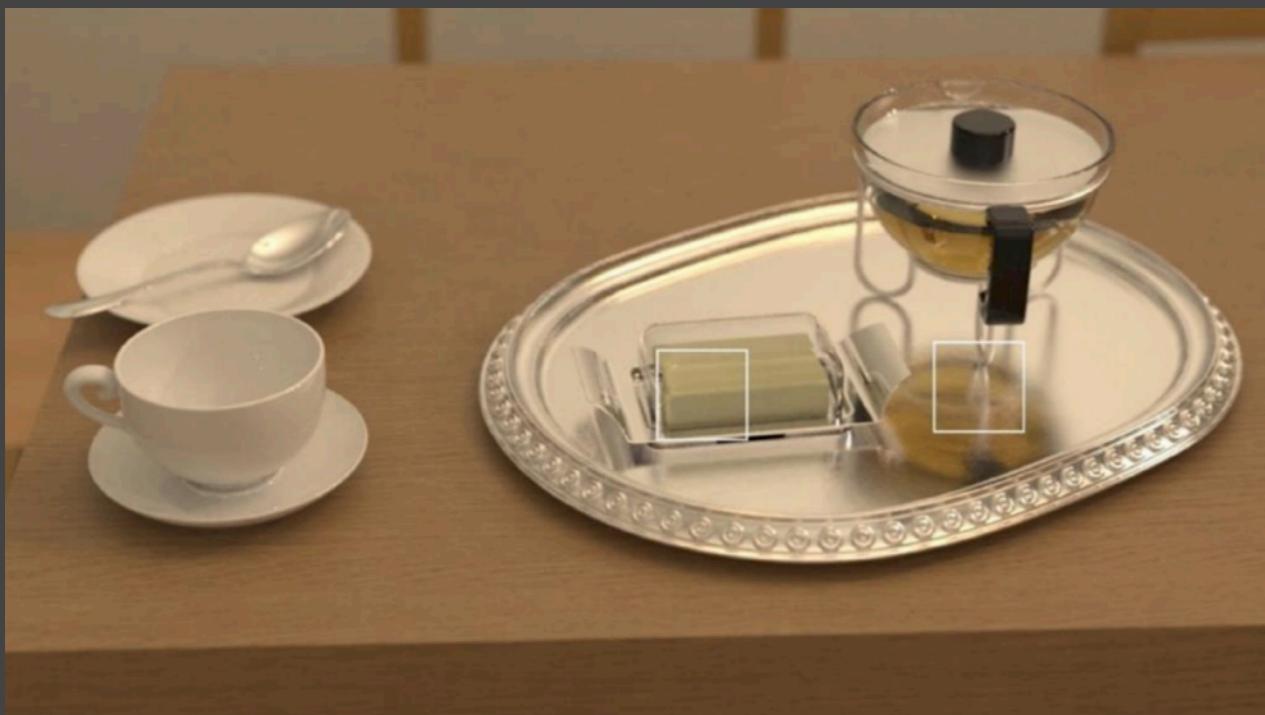


CSGO PoV Cam set up in Unreal Engine

[<https://www.youtube.com/watch?v=3TQ18SmQSw0>]

What is GAMES202 NOT about?

- Expensive (but more accurate) light transport techniques in movies / animations (where can I learn this?)



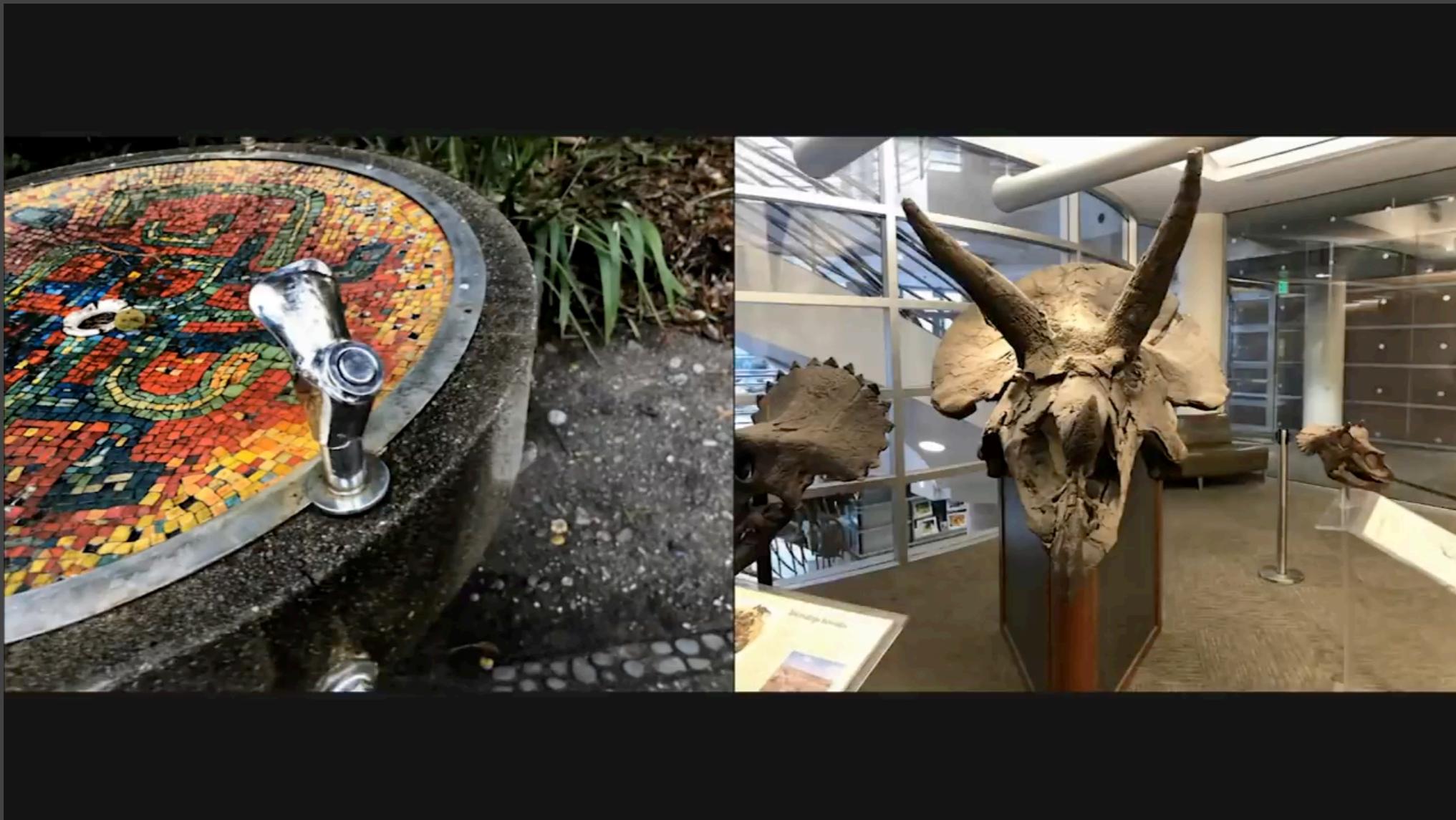
Manifold Metropolis Light Transport
Jakob et al.



Gradient Domain Path Tracing
Kettunen et al.

What is GAMES202 NOT about?

- Neural Rendering



NeRF: Representing Scenes as Neural Radiance Fields for View Synthesis
[Mildenhall et al.]

What is GAMES202 NOT about?

- Using OpenGL
- Scene / shader optimization
- Reverse engineering of shaders
- High performance computing
e.g. CUDA programming

Questions?

How to study GAMES202?

- Understand the difference between science and technology
 - Science != technology
 - Science == knowledge
 - Technology == engineering skills that turn science into product
- Real-time rendering =
fast & approximate offline rendering + systematic engineering
- Fact: in real-time rendering technologies,
the industry is way ahead of the academia
- Practice makes perfect

How to study GAMES202?

- If you are watching live streams of this course
 - Be active asking questions!
- If you are watching recordings
 - 1.25x - 1.5x playback speed is recommended!

Why study GAMES202?

Computer Graphics
is
AWESOME!

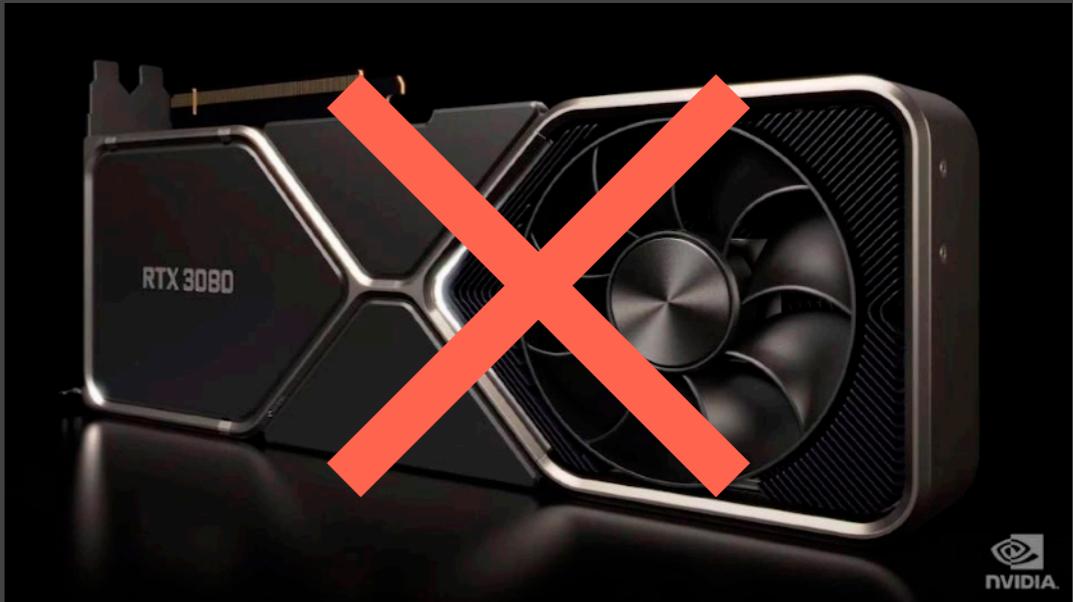
Course Logistics

Prerequisites

- Strong interest in Rendering, Graphics
- Computer Graphics experience
 - GAMES101 or equivalent
 - Basic calculus
- What else to be prepared?
 - Basic OpenGL Shader Language (GLSL)!
 - The next lecture will briefly review it
 - Assignment 0 (optional, will be released with the next lecture)
will help you warm up quickly

General Information

- Modern Course
 - Comprehensive but no need to have **extreme hardware!**
 - Pace / contents subject to change
- Course Website
 - <http://www.cs.ucsb.edu/~lingqi/teaching/games202.html>
 - Has all the needed information
 - Syllabus, slides, reading materials, etc.



References

- No Required Textbooks
 - Reading materials (if any) will available online before lectures
 - Mainly SIGGRAPH courses + engine design docs
 - Lecture slides will be available after class
- Possible reference
 - Akenine-Moller et al., "Real-time Rendering", 4th edition.
 - Still not quite related
(unlike the tiger book to GAMES101)

