Rendering: Introduction

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What this lecture is about

- Why should you invest time in this course?

Source: MR_Stein, flickr.com, CC BY-NC 2.0. Edges blurred.
Heroes of Rendering: James Kajiya

- Developer of the Rendering Equation and path tracing algorithm (1986)
- PhD 1979, University of Utah
- Professor at California Institute of Technology (Caltech)
- Currently at Microsoft

What is Path Tracing?

- Ray-tracing
  - Shoot rays into the scene, report on hit objects
  - Bounce into new directions, stop after some time
  - No claim to authenticity (but so shiny!)

- Path Tracing
  - Theoretically infinite bounces (high quality)
  - Approximates actual light transport (physically-based)
  - Many advanced SFX are just a side product!

- We will be developing an unbiased path tracer (?)
Goals of this lecture

- Understanding the nature of light and color
- Modeling light transport for image synthesis
- Generation of realistic (or artistic), high-quality images
- Making the rendering process as effective as possible
Prerequisites

- General interest in computer graphics
- Basic programming skills (C++)
- Fundamentals of higher mathematics:
  - Interpreting moderately complex formulas
  - Linear algebra (vectors, matrices, spaces)
  - Probability & statistics essentials
  - Calculus (integrals, derivatives)

If you need a recap or introduction to mathematical foundations:
- Early chapters of the course book
- For a more didactic approach, consider the 3blue1brown series on linear algebra and calculus
Course Structure

- Lecture (held by Adam Celarek & Bernhard Kerbl)
  - Wednesday at 16:00, s.t.
  - COVID-19: Course is online! Time slot used for Q&A!

- Lab exercise
  - 4 programming exercises, based on Nori renderer
  - Framework download and submissions via Git
  - Must be solved individually (no group work!)

- Final exam
Lecture Roadmap

Background and Basics

Light Physics → Monte Carlo Integration → Rendering Equation → Path Tracing 1 → Sampling

Making Things Faster

Path Tracing 2 → Multiple Importance Sampling → Next Event Estimation → Spatial Acceleration Structures

Making Things Prettier

Materials → The End
How to Succeed in this Course

- Two paths to victory
  - The efficient way
    - Do minimal required work, implement formulas we give you
    - Study well for final exam
  - The effective way
    - Prod at formulas, follow derivations, implement bonus tasks
    - You can accumulate enough points to skip the exam!
What to do for a passing grade

- Do the lab exercises
  - Requirements for passing: \( >15 \text{ pts per assignment} \)
  - You can obtain extra points for putting in additional effort
  - Excellent solutions may earn enough points (160+) to skip exam!

- Study for the final exam (80 pts)
  - Questions will be based on lecture topics
  - Held towards the end of the course

- Grading: \( \geq 100 = 4, \geq 120 = 3, \geq 140 = 2, \geq 160 = 1 \)
Communication

- Lecture slides: course homepage
- Official announcements: via TUWEL, TISS
- Discussion topics for lecture contents: via TUWEL
- Mistakes, issues, special actions: via direct mail
- Submissions and Testing: submission.cg.tuwien.ac.at
Communication

**Good** ideas:
- Talking about lecture contents with us or your colleagues ✓
- Asking questions on TUWEL ✓ ✓
- Writing us mails regarding mistakes in the material ✓ ✓ ✓
- Sending us your code (√)

**Bad** ideas:
- Sending mails before checking the course materials X
- Sharing code with your colleagues X X
- Posting code on TUWEL X X X
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Course Materials

- Lecture Book (highly recommended)
  - Physically Based Rendering, 3rd edition
  - Available for free on the book’s homepage

- Course page
  - https://www.cg.tuwien.ac.at/courses/Rendering/VU
  - TUWEL and TISS course pages

- Lecture Slides

- Assignment Sheets (will be released during the semester)
Eurographics: Student Volunteers Wanted!

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