Rendering: Introduction

Adam Celarek and Bernhard Kerbl

Research Division of Computer Graphics
Institute of Visual Computing & Human-Centered Technology
TU Wien, Austria

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.

Source: Gilles Tran, Wikipedia, “Ray Tracing”

Heroes of Rendering: James Kajiya

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

Source: Wikipedia, “Jim Kajiya”, Dcoetzee – Own work. CC 0. Image flipped.

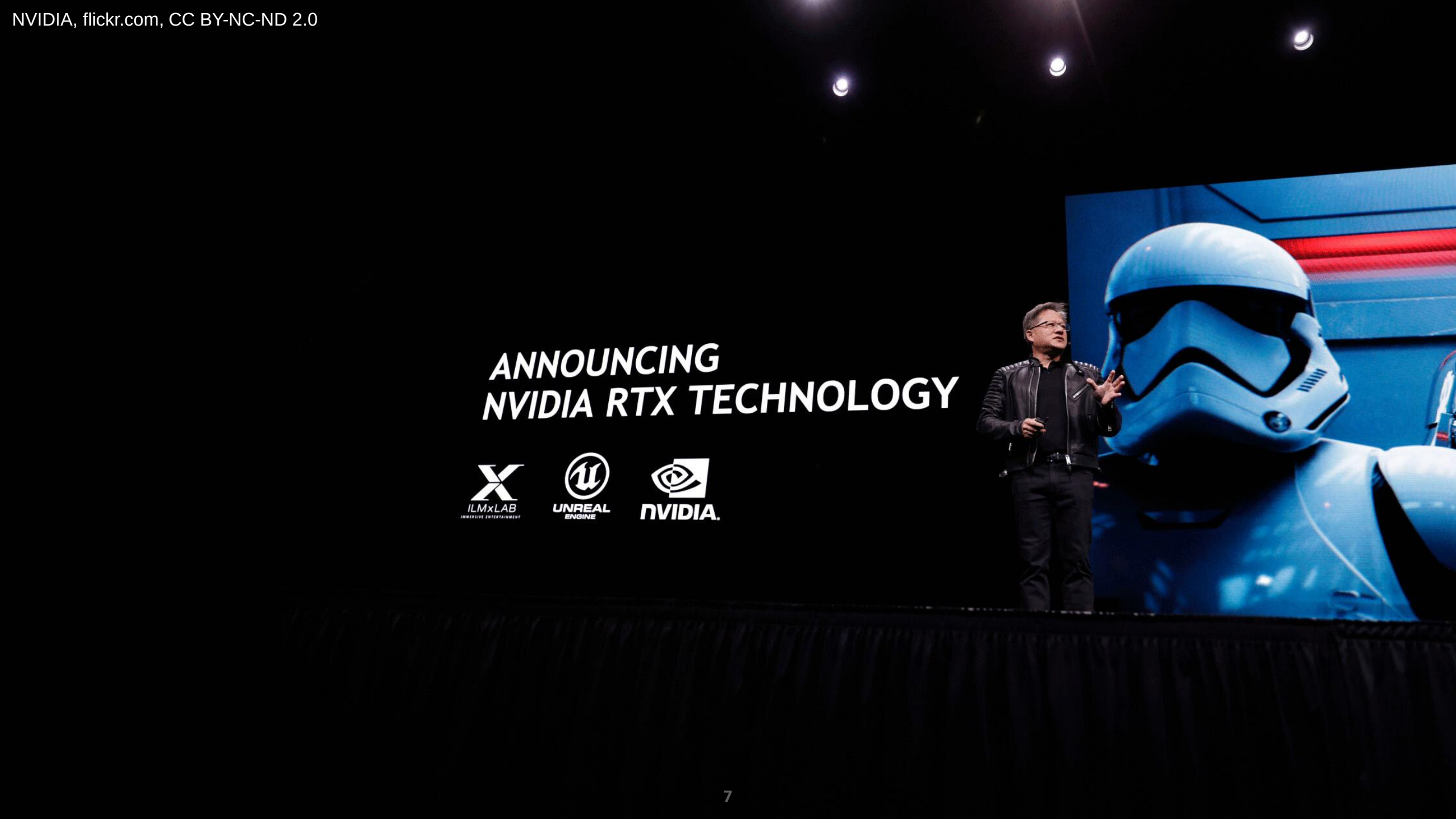
James Kajiya

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 (?)

Spring, © Blender Foundation | cloud.blender.org/spring

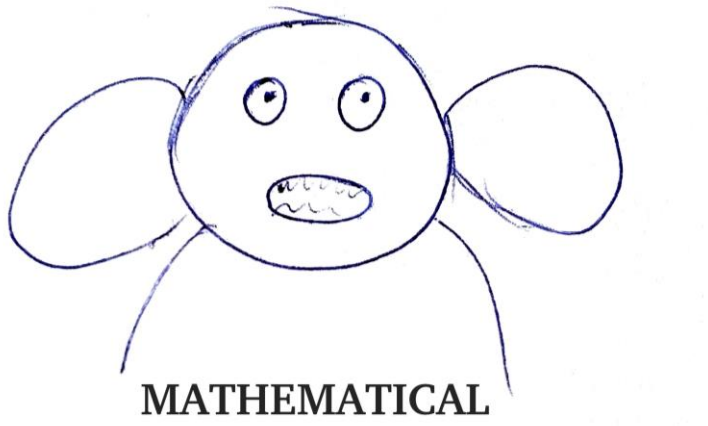


Goals of this lecture

- 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)

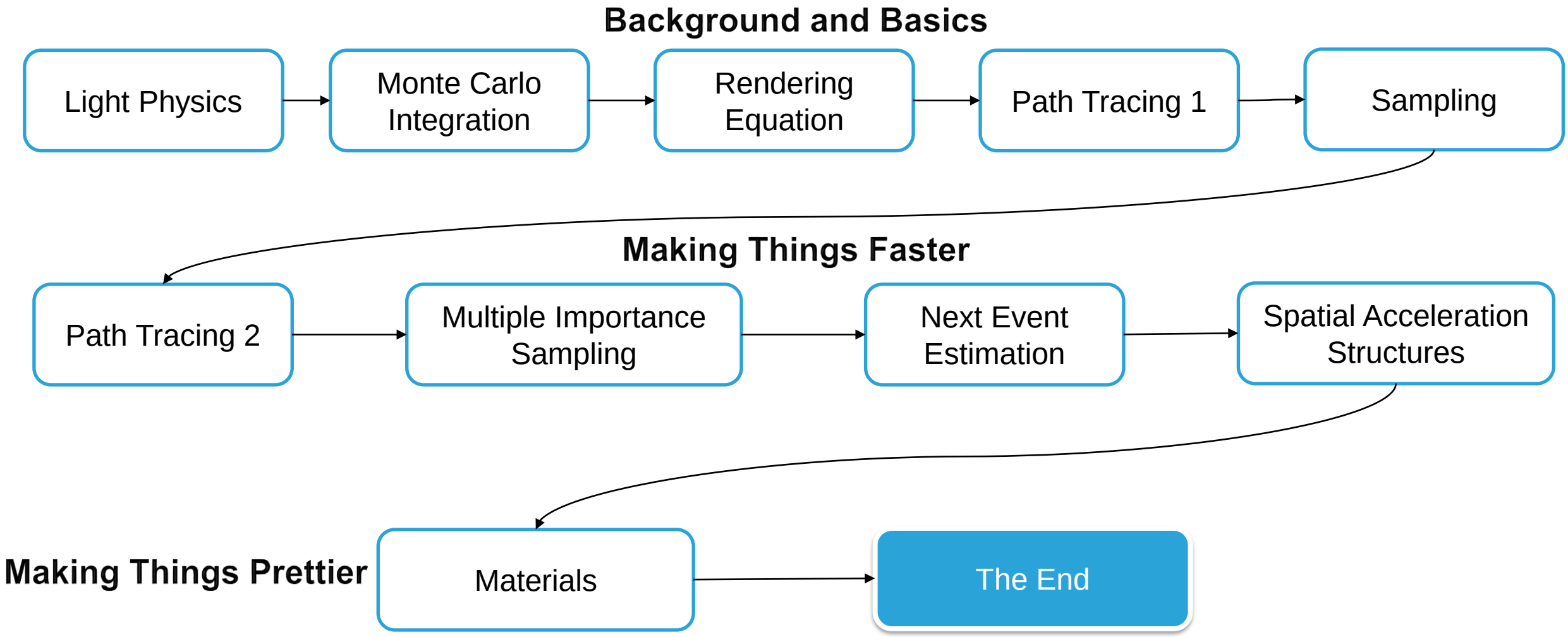
If you need a recap or introduction to mathematical foundations:

- Early chapters of the course book
- For a more didactic approach, consider *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



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 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 ✗
- Sharing code with your colleagues ✗ ✗
- Posting code on TUWEL ✗ ✗ ✗

Contact

Adam Celarek

<last_name> (at) cg.tuwien.ac.at

cg.tuwien.ac.at/staff/AdamCelarek.html

Hamed Jafari

<firstname.lastname>.s@gmail.com

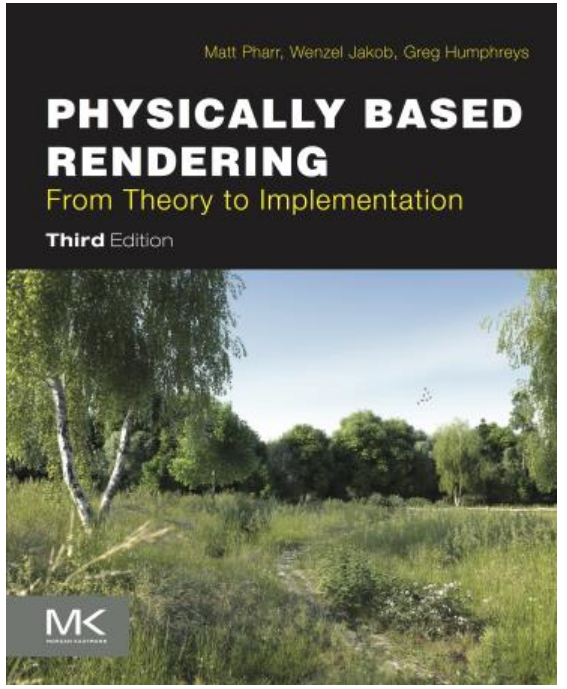
Bernhard Kerbl

<last_name> (at) cg.tuwien.ac.at

cg.tuwien.ac.at/staff/BernhardKerbl.html

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)

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