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.

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.

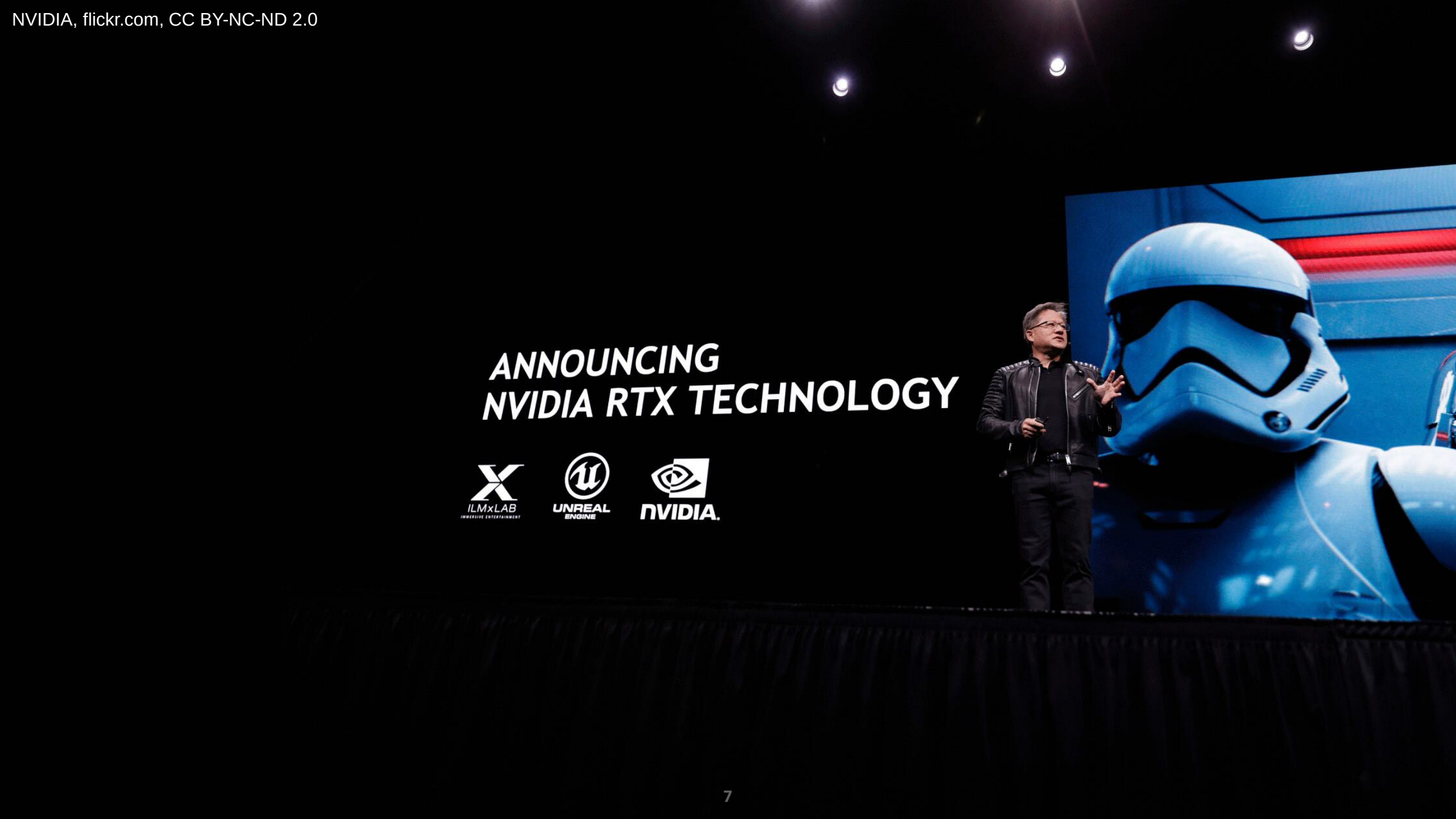
James Kajiya

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

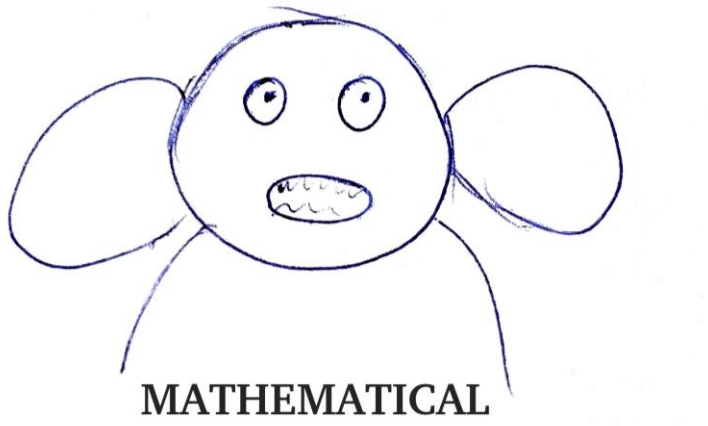


Goals of this lecture

- 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)

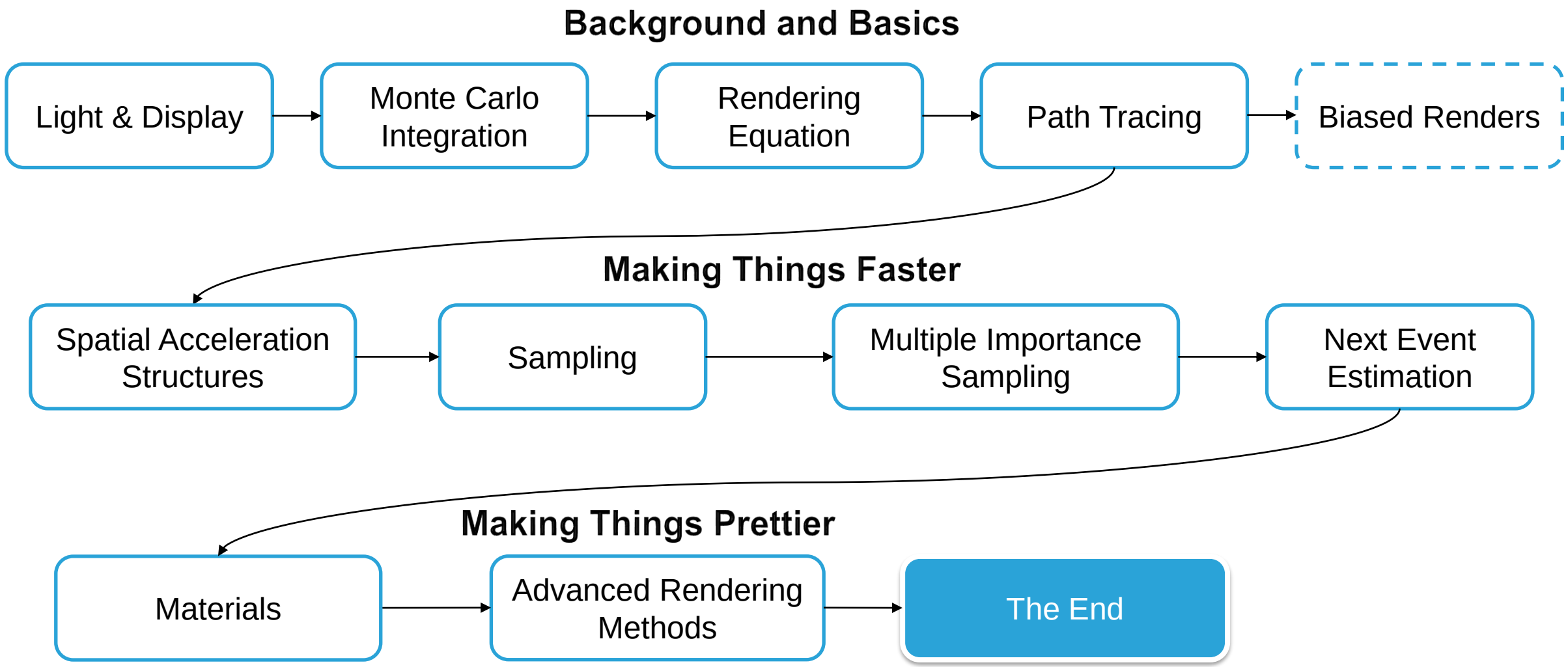
If you need a recap or introduction to mathematical foundations:

- 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 and Torsten Möller)
  - Two modi: 3 ECTS (Tuesdays only) and 6 ECTS (both days)
  - Will differ in terms of requirements for assignments and exam
  - Tuesday at 11:00, c.t. (obligatory for all participants)
  - Thursday at 11:05, s.t. (obligatory for Uni Wien, optional for TU Wien)
- Lab exercise
  - 3 assignments + 1 project, based on Nori renderer
  - Framework download and submissions via Git
  - Must be solved individually (no group work!)

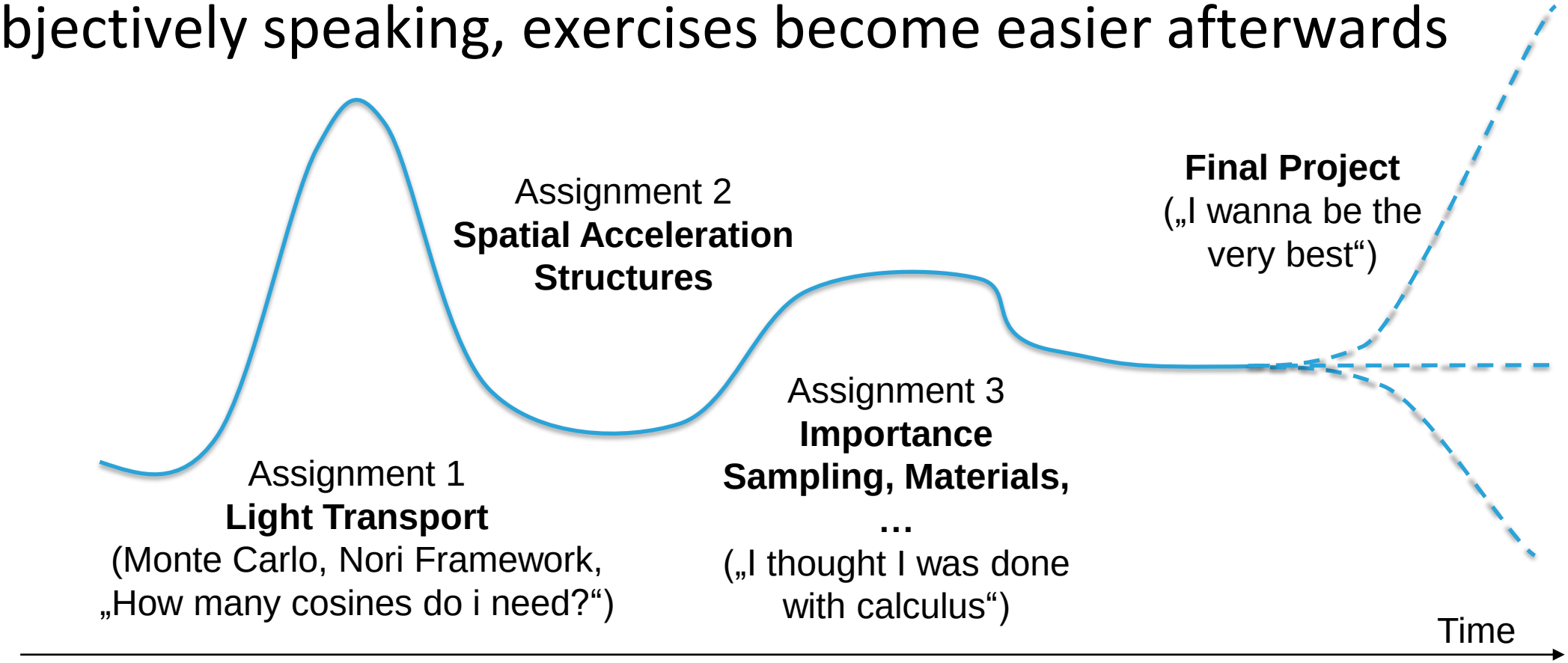
Lecture Roadmap



Assignments and Learning Curve

- Getting used to framework and most new concepts at beginning

- Subjectively speaking, exercises become easier afterwards



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
  - 120 points from core exercises
  - 1000+ points from bonus tasks
  - Requirements for passing**: >15 pts per assignment**

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

Grading Modi

- 3 ECTs version:
  - Final exam yields 80 points (45 minutes)
  - Bonus lab exercises may earn enough points (175+) to skip exam!
  - Lab + exam points: $\geq 100 = 4, \geq 125 = 3, \geq 150 = 2, \geq 175 = 1$
- 6 ECTs version
  - Final exam yields 150 points (90 minutes)
  - Need at least 50 points on exam (no skipping!)
  - Lab + exam points: $\geq 150 = 4, \geq 187 = 3, \geq 225 = 2, \geq 260 = 1$

Communication

- Lecture slides: course homepage
- Announcements: via TUWEL (make sure to enable notifications!)
- 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

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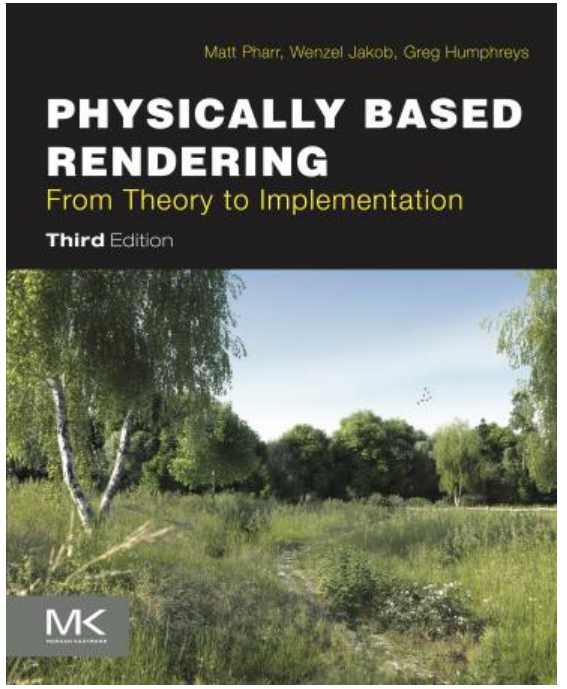
Course Materials

- Lecture Book (highly recommended)
  - Physically Based Rendering, latest 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)