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# Computer Graphics

- Introduction -

**Hendrik Lensch**

# Overview

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- **Today**
  - Administrative stuff
  - Introduction
- **First lecture**
  - Ray Tracing I

# General Information

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- **Core Lecture (Stammvorlesung)**
  - Applied Computer Science (Praktische Informatik)
- **Lectures in English**
- **Time and Location**
  - Mo 8:30-10h, HS 02, E1.3
  - Th 8:30-10h, HS 02, E1.3
- **ECTS:**
  - 9 credit points
- **Web-Page**
  - <http://www.mpi-inf.mpg.de/departments/d4/teaching/ws2007-2008/cg>
  - Schedule, Slides as PDF
  - Literature, Assignments, other Information
- **Sign up for course and e-mail list on web page !**

# People

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- **Lecturer**
  - Hendrik Lensch
    - MPI, E1.4, Room 228
    - Tel. 428, Email: [lensch at mpi-inf.mpg.de](mailto:lensch@mpi-inf.mpg.de)
- **Assistants**
  - Art Tevs
    - MPI, E1.4, Room 219
    - Tel. 419, Email: [tevs at mpi-inf.mpg.de](mailto:tevs@mpi-inf.mpg.de)
  - Boris Ajdin
    - MPI, E1.4, Room 206
    - Tel. 406, Email: [bajdin at mpi-inf.mpg.de](mailto:bajdin@mpi-inf.mpg.de)
  - Matthias Hullin
    - MPI, E1.4, Room 213
    - Tel. 406, Email: [bajdin at mpi-inf.mpg.de](mailto:bajdin@mpi-inf.mpg.de)

# People

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- **Secretary**
  - Sabine Budde
    - MPI, E1.4, Room 402
    - Tel. 400, Email: [budde at mpi-inf.mpg.de](mailto:budde@mpi-inf.mpg.de)
- **Teaching Assistants**
  - Michael Kunz
    - Email: [mkunz at mpi-inf.mpg.de](mailto:mkunz@mpi-inf.mpg.de)
  - Sebastian Mezzavilla
    - Email: [mezzavil at mpi-inf.mpg.de](mailto:mezzavil@mpi-inf.mpg.de)

# Exercise Groups

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- **Group I, Tue 08:00 – 10:00, Matthias Hullin**
- **Group II, Tue 16:00 – 18:00, Michael Kunz**
- **Group III, Thu 14:00 – 16:00, Sebastian Mezzavilla**
- **You need to register twice:**
  - write email to Art Tevs: [tevs at mpi-inf.mpg.de](mailto:tevs@mpi-inf.mpg.de)
    - subject: “[CG0708] Registration”
    - your name, date of birth, student ID, exercise group first choice, second choice
  - HISPOS

# Weekly Assignments

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- **Weekly assignment sheets**
  - Mo to Mo, starting next week
  - Theoretical & programming assignments
    - You will build your own ray tracing system
    - System will be the basis for the Rendering Competition
  - Not graded, **BUT**
    - Minimum of 30% per exercise sheet
    - Average of >50% of assignments required for admission to final exam
  - Hand in assignments by next Monday
    - Theoretical: in paper form
    - Code: E-Mail to assistant
  - Exercise meetings
    - You present correct solutions
    - Discuss problems with Bremser
      - ➔ Sign-up through registration
  - Groups of max. 2 students allowed

# Grading

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- **Rendering Competition**
  - Counts 30% towards final grade
    - Technical merit & artistic quality (jury)
  - Groups of max. 2 students
  - Minimum: 50% to pass
  - Special prizes
  
- **Final Exam, February 22nd**
  - Counts 70% towards final grade
  - Minimum: 50% to pass

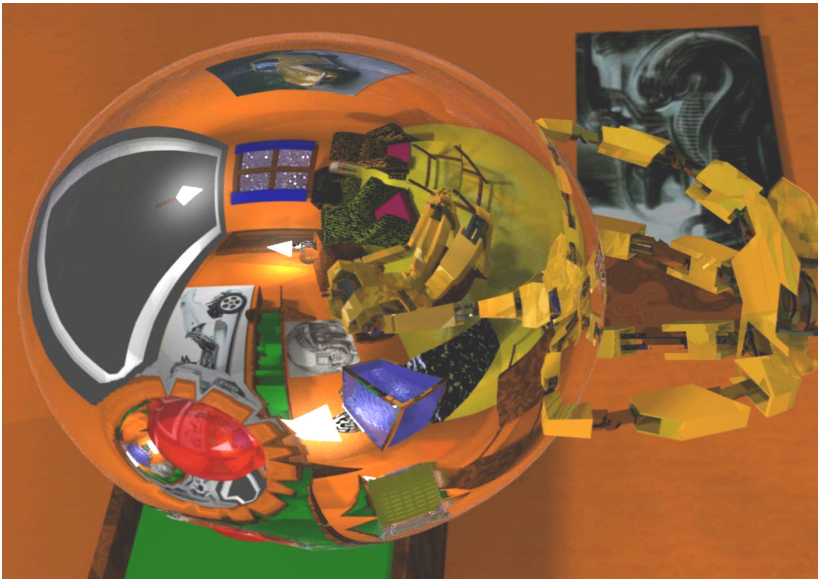
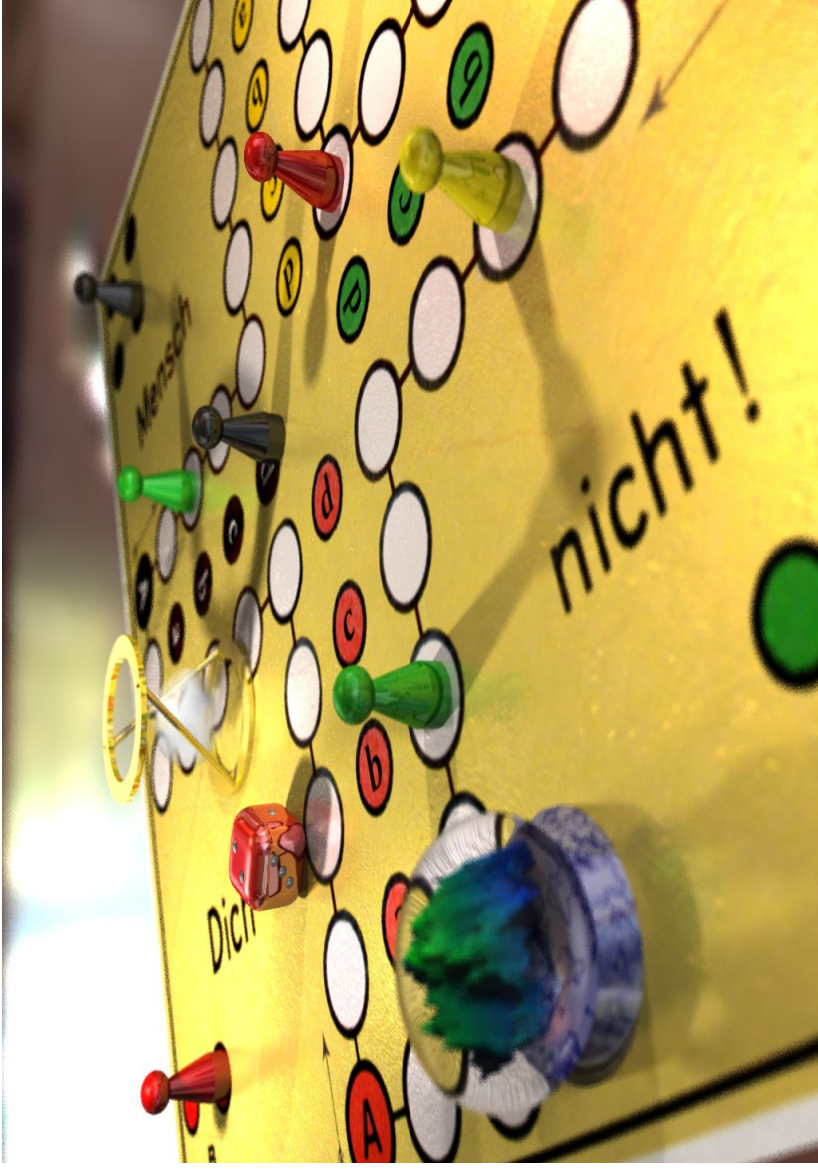


# Master & Bachelor Students

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- **You must register for this course to get credits**
  - Web page, HISPOS!
- **You may cancel the course until November 27th**
  - By sending email to me
- **If you are still registered after that, you should**
  - (attend the lectures)
  - participate in the exercise groups
  - take part in the rendering competition, and
  - take the final exam
- **If not, you**
  - Fail the course

# Rendering Competition



# Rendering Competition

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- **Task**
  - Create a realistic image of a virtual environment
  - Several combined assignment instead of one mid-term exams
  - Incorporate advanced technical features into your ray tracer
    - List of new features and techniques with rating
    - Collect > 50% of required points to pass
    - Bonus points count towards exam
  - Design an interesting animation
    - Modeling and shading
    - Aesthetic composition
    - Use new features for best results
- **Due after Christmas**
  - Render a small animation
  - Web page with technical detail info

# Text Books

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- **Suggested Readings:**
  - Matt Pharr, Greg Humphreys, *Physically Based Rendering : From Theory to Implementation*, Morgan Kaufmann Series, 2005
  - Peter Shirley, *Fundamentals in CG*, 2. Ed, AK Peters, 2005
  - Alan Watt, *3D Computer Graphics*, Addison-Wesley, 1999
  - Foley, Van Dam, et al., *Computer Graphics: Principles and Practice*, Addison-Wesley, 2. Ed, 1996
  - Andrew Glassner, *An Introduction to Ray-Tracing*, Academic Press, 1989
  - Andrew Glassner, *Principles of Digital Image Synthesis*, 2 Bände, Morgan Kaufman, 1995
  - Andrew Woo, et al., *OpenGL Programming Guide*, 3. Ed., Addison-Wesley, 1999
  - Thomas Akenine-Möller, Eric Haines, *Real-Time Rendering*, 2<sup>nd</sup> Ed., AK Peters, 2002
  - Randima Fernando, Mark Kilgard, *The Cg Tutorial*, Addison Wesley, 2003
  - Randima Fernando, *Cg Gems*, Addison Wesley, 2004
  - **NVIDIA CUDA – Programming Guide**

# Course Syllabus (1)

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- **Ray Tracing**
  - Basics intersections
  - Acceleration strategies
- **Light Transport**
  - Interaction of light and matter
  - Simulating light distributions
  - Textures
- **Signal Processing**
  - Filtering
  - Sampling and Antialiasing
- **Colors and Perception**
  - Human Visual System
  - Colors and Tone Reproduction
- **GPU Programming**
  - OpenGL
  - Shader Programming
  - Cuda

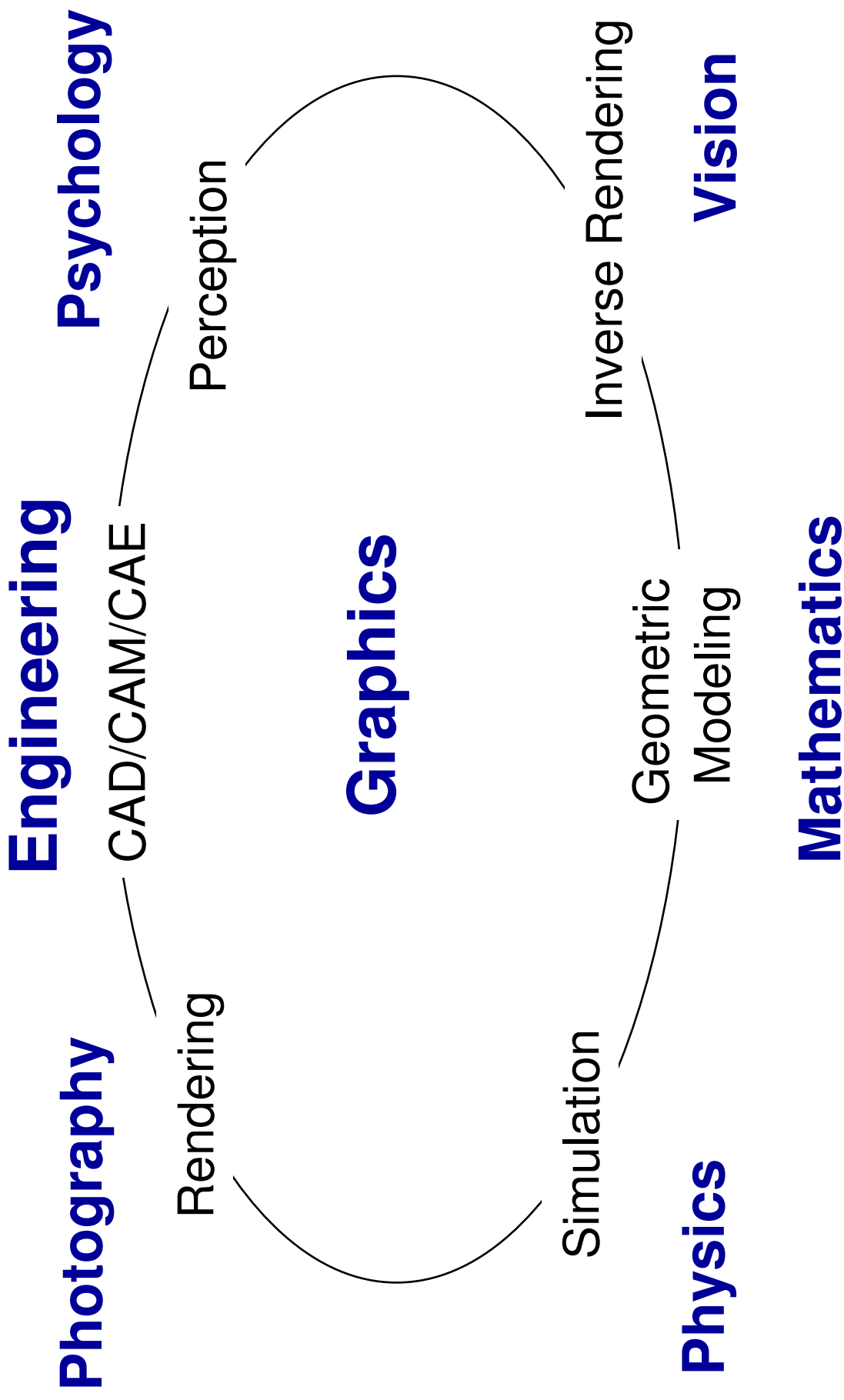
# Course Syllabus (1)

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- **Interaction, Images and Video**
  - Input devices
  - Output devices
  - Compression
  - Image-based rendering
- **Modeling**
  - splines
  - subdivision surfaces
- **Visualization**
  - Volume Rendering
  - Scientific Visualization

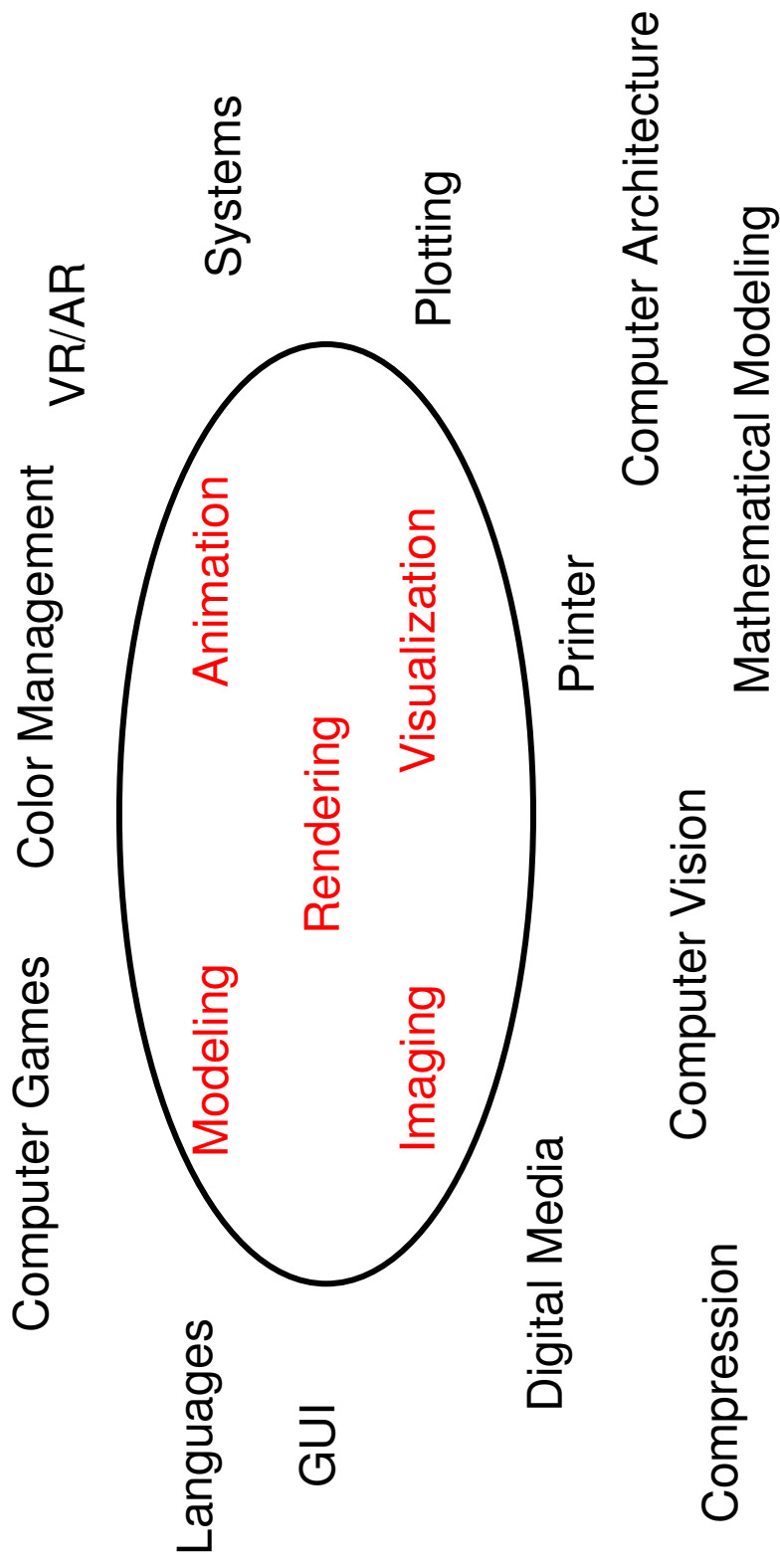
# What is Computer Graphics ?

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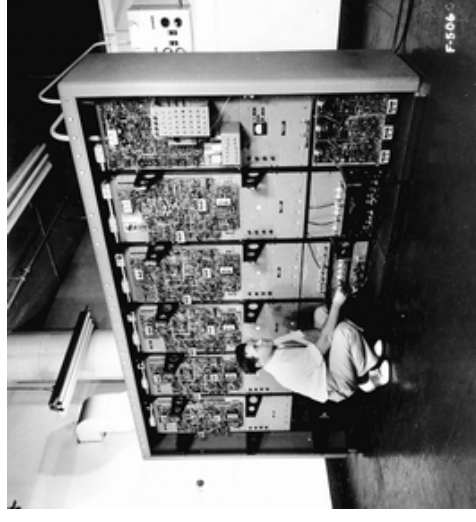
And, and, and, ....



# Historical Perspective

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- **A short history of graphics:**
  - 1950: MIT Whirlwind (CRT)
  - 1955: Sage, Radar with CRT and light pen
  - 1958: Willy Higinbotham “Tennis for Two”
  - 1960: MIT „Spacewar“ on DEC PDP-1
  - 1963: Ivan Sutherland’s „Sketchpad“ (CAD)
  - 1969: ACM Siggraph founded
  - 1968: Tektronix storage tube (\$5-10.000)
  - 1968: Evans&Sutherland (flight simulators) founded
  - 1968: Douglas Engelbart: computer mouse
  - 1970: Xerox: GUI
  - 1971: Gourand shading
  - 1974: Z-buffer
  - 1975: Phong shading model
  - 1976: First animations rendered
  - 1979: Eurographics founded
  - 1980: Whitted: Ray tracing



# Historical Perspective

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- **A short history of graphics (Cont.):**
  - 1981: Apollo Workstation, IBM PC
  - 1982: Silicon Graphics (SGI) founded
  - 1984: X Window System
  - 1984: First Silicon Graphics Workstations (IRIS GL)
  - Until mid/end of 1990s: Dominance of SGI in the high end
    - HW: RealityEngine, InfiniteReality, RealityMonster, ...
    - SW: OpenGL, OpenInventor, Performer, Digital Media Libs, ...
  - End of 1990s:
    - Low- to mid range taken over by „PCs“ (Nvidia, ATI, ...)
      - HW: Fast development cycles, Graphics-on-a-chip, ...
      - SW: Direct 3D & OpenGL, computer games
  - 1995: First feature film “Toy Story”
  - Today
    - Programmable graphics hardware, Cg, Cuda
    - Realtime Ray Tracing

# Wrap-Up

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- **Computer Graphics**
  - Rendering
  - Modeling
  - Visualization
  - Animation
  - Imaging
- **Young, dynamic area**
  - Progress driven by research & technology
- **Big industry!**
- **Interdisciplinary field**
  - Relations to mathematics, physics, engineering, psychology, art, entertainment, ...